RETURN TO CODE 6510 FILES

INSTRUCTIONS

FOR

SIGNAL GENERATOR

TYPE 215-C

CONFIDENTIAL
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Date
(FOLD)

BOONTON RADIO CORPORATION
BOONTON, NEW JERSEY
U. S. A.

MP MASTER
MA24360

RETURN TO CODE FILES

NOTICE

This instruction book was originally written for Signal Generator TS-155B/UP (BRC type 215A) . To facilitate the testing of Black Maria Equipment TN103/APX, certain changes have been incorporated in the TS-155B/UP Signal Generator, and equipment thus modified has been designated as BRC type 215C. Where ever TS-155B/UP appears in the text of this instruction book, it should be read as BRC type 215C.

The changes in the TS-155B/UP Signal Generator are as follows:

1. The common connection between the center conductor pins of Trigger Jacks J-1 and J-2 has been removed.

2. Trigger Jack J-1 remains connected between the switch arm of S2D and ground.

Note:- On certain pages of this manual, reference is made to Trigger Jacks J-1 and J-2. These references should be interpreted to mean Trigger Jack J-1 only.

3. The value of resistor R-41 has been change from 8.2 K ohms to 2.7 K ohms.

4. A new resistor, R-58 (5.6 K ohms) has been added between R-41 and the cathode of V-6.

5. Trigger Jack J-2 is connected between ground and the junction point of resistors R-41 and R-58.

6. Trigger Jack J-2 is identified as "SYNC OUT TRIGGER JACK".

7. The tuning range of the R.F. oscillator has been changed from 2700-2900 mc to 2780-2990 mc.

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WARNING

HIGH VOLTAGE

is used in the operation of the signal generator
and the components of the radar equipment
with which the test equipment is used.

DEATH ON CONTACT

may result if personnel
fail to observe safety precautions.

Be careful to avoid contact with high-voltage circuits or 115-volt a-c input connections while checking or servicing the radio equipment. Make certain that the power is turned off before disassembling the signal generator to perform maintenance.

FIRST AID TREATMENT FOR ELECTRIC SHOCK

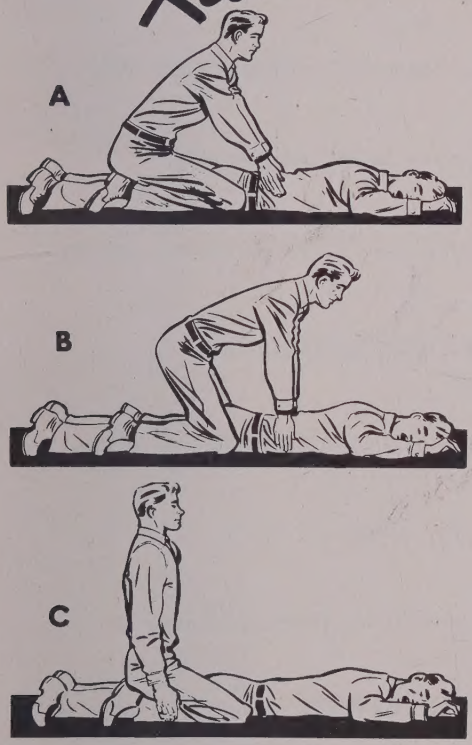
I. FREE THE VICTIM FROM THE CIRCUIT IMMEDIATELY.

Shut off the current. If this is not immediately possible, use a dry nonconductor (rubber gloves, rope, board) to move either the victim or the wire. Avoid contact with the victim. If necessary to cut a live wire, use an axe with a dry wooden handle. Beware of the resulting flash.

II. ATTEND INSTANTLY TO THE VICTIM'S BREATHING.

Begin resuscitation at once on the spot. Do not stop to loosen the victim's clothing. Every moment counts. Keep the patient warm. Wrap him in any covering available. Send for a doctor. Remove false teeth or other obstructions from the victim's mouth.

Resuscitation



POSITION

1. Lay the victim on his belly, one arm extended directly overhead, the other arm bent at the elbow, the face turned outward and resting on hand or forearm, so that the nose and mouth are free for breathing (fig. A).

2. Straddle the patient's thighs, or one leg, with your knees placed far enough from his hip bones to allow you to assume the position shown in figure A.

3. Place your hands, with thumbs and fingers in a natural position, so that your palms are on the small of his back, and your little fingers just touch his lowest ribs (fig. A).

FIRST MOVEMENT

4. With arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear upon the victim. Your shoulders should be directly over the heels of your hands at the end of the forward swing (fig. B). Do not bend your elbows. The first movement should take about 2 seconds.

SECOND MOVEMENT

5. Now immediately swing backward, to remove the pressure completely (fig. C).

6. After 2 seconds, swing forward again. Repeat this pressure-and-release cycle 12 to 15 times a minute. A complete cycle should require 4 or 5 seconds.

CONTINUED TREATMENT

7. Continue treatment until breathing is restored or until there is no hope of the victim's recovery. Do not give up easily. Remember that at times the process must be kept up for hours.

8. During artificial respiration, have someone loosen the victim's clothing. Wrap the victim warmly; apply hot bricks, stones, etc. Do not give the victim liquids until he is fully conscious. If the victim must be moved, keep up treatment while he is being moved.

9. At the first sign of breathing, withhold artificial respiration. If natural breathing does not continue, immediately resume artificial respiration.

10. If operators must be changed, the relief operator kneels behind the person giving artificial respiration. The relief takes the operator's place as the original operator releases the pressure.

11. Do not allow the revived patient to sit or stand. Keep him quiet. Give hot coffee or tea, or other internal stimulants.

HOLD RESUSCITATION DRILLS REGULARLY

TL 37451

DESTRUCTION NOTICE

WHY —To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN—When ordered by your commander.

HOW —1. Smash — Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

2. Cut — Use axes, handaxes, machetes.

3. Burn — Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

4. Explosives — Use firearms, grenades, TNT.

5. Disposal — Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT

WHAT—1. Smash — Meter, knobs, switches, cavity, thermistor, r-f plumbing, and all tubes.

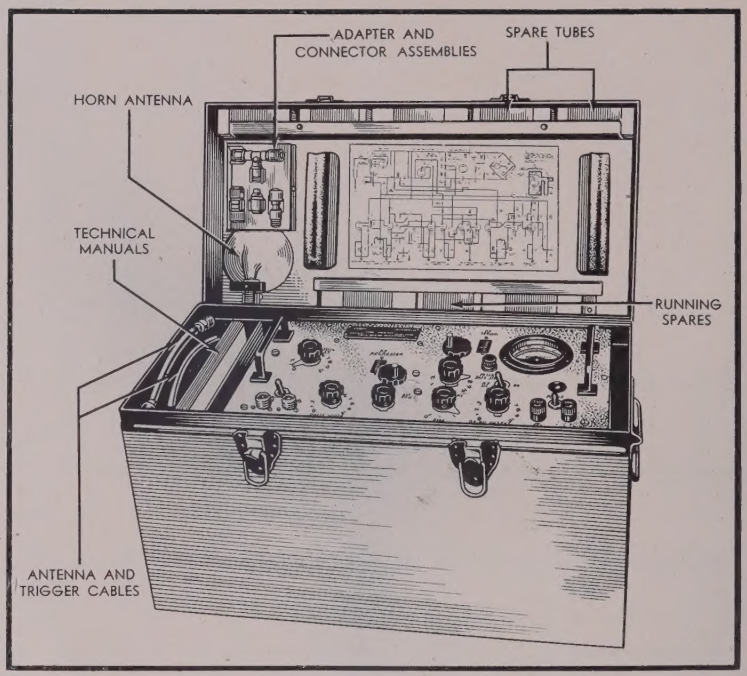
2. Cut — Cables and wiring.

3. Burn — Technical manuals, schematic diagrams, cables, and wiring.

4. Bend — Panel and chassis.

5. Bury or scatter — All of the above pieces after destroying their usefulness.

DESTROY EVERYTHING



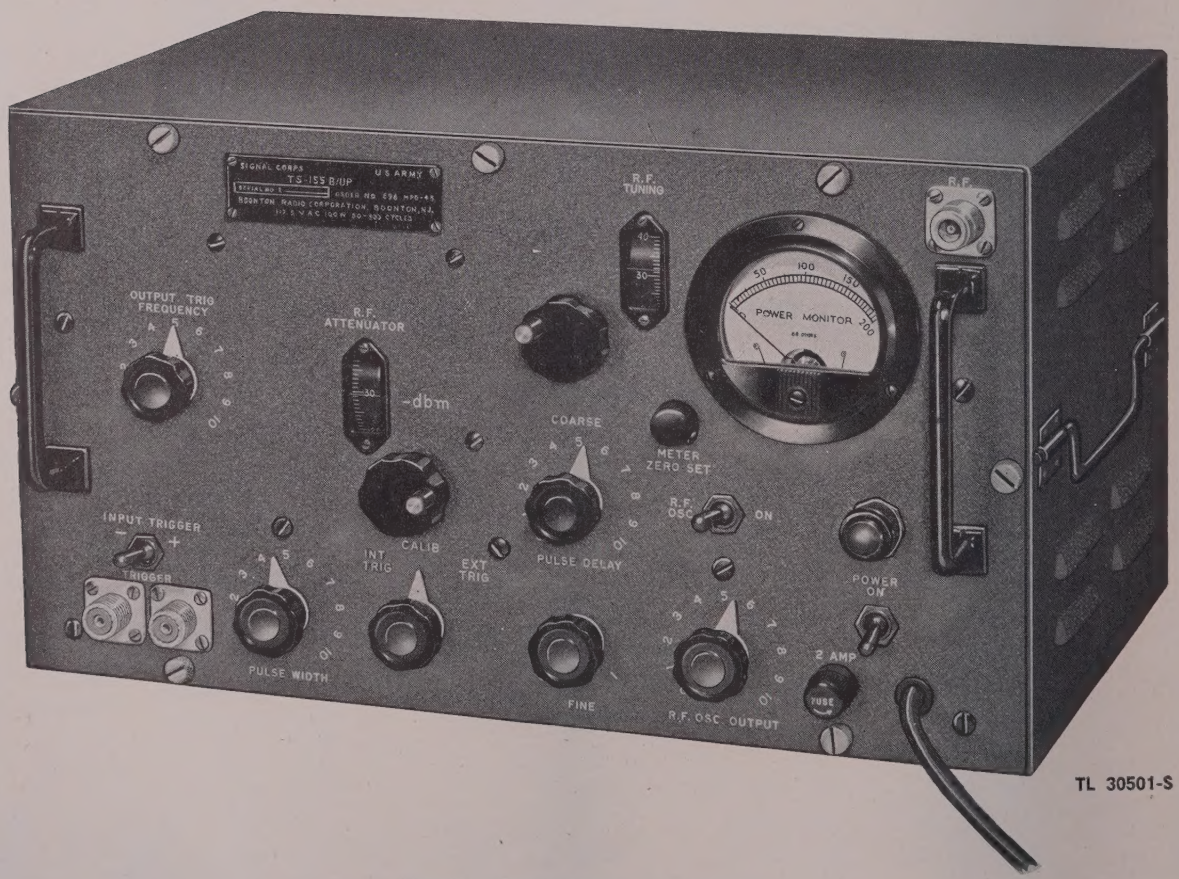


Figure 1. Signal Generator TS-155B/UP.

PART ONE

INTRODUCTION

SECTION I. DESCRIPTION OF SIGNAL GENERATOR TS-155B/UP

1. GENERAL.

Signal Generator TS-155B/UP (fig. 1) is a generator of pulse-modulated, calibrated, radio-frequency (r-f) signals. It is used for testing the operation of radar sets in the band of frequencies from 2,700 to 2,900 megacycles (mc) per second. As a signal generator, it measures or checks the sensitivity of the radar receiver; as an r-f wattmeter, it measures or checks the power output of the radar transmitter.

2. NOMENCLATURE.

Signal Generator TS-155B/UP is similar in operating characteristics to the preceding types, Signal Generators TS-155/UP and TS-155A/UP, described in TM 11-2657.

3. APPLICATION.

The signal generator may be used in any of the following ways:

a. As a pulsed signal generator pulse-modulated by an internal pulse generator. The pulse characteristics such as pulse width, pulse delay, and pulse frequency are continuously variable over a limited range.

b. As a pulsed signal generator triggered from an external source. A trigger inverter is supplied to permit the use of either positive or negative triggers. Pulse width and pulse delay are variable.

c. As a power monitor. A thermistor connected in one arm of a Wheatstone bridge is mounted directly in the r-f line between the cavity and attenuator so as to absorb a constant fraction of the power generated by the oscillator. The resistance of the thermistor arm of the bridge varies with the r-f power flowing in the thermistor. The corresponding unbalance of the bridge is indicated by the power monitor meter, the readings being directly proportional to the r-f power absorbed by the thermistor.

(*1*) The r-f power generated by the oscillator is delivered to the R.F. jack through a variable attenuator. When used in conjunction with the power monitor meter, the R.F. ATTENUATOR dial reads peak power directly in decibels below 1 milliwatt (—dbm) over the range from —20 to —100 dbm.

(*2*) The power monitor is also capable of measuring the average power from an external source delivered to the R.F. jack. The energy to be measured is delivered to the monitoring system through the attenuator, and the amount is read on the power monitor meter directly in milliwatts.

d. As an uncalibrated absorption-type frequency meter. The tunable cavity of the oscillator may serve as the tuned circuit of a frequency meter. The power under test is delivered to the R.F. jack and is coupled to the power monitoring system through the attenuator. When the cavity is tuned through resonance, the power monitor meter reading passes through a minimum. If all cavity adjustments are left unchanged, the signal generator may be used as an r-f oscillator, generating power at a frequency close to that of the external source used to tune the cavity.

4. TECHNICAL CHARACTERISTICS OF SIGNAL GENERATOR TS-155B/UP.

Input power.....100 watts (w) at 117.5 volts (v).
105 to 125 v.
50 to 800 cycles.

Output:

Radio frequency.....2,700 to 2,900 mc.

R-F power output.....As indicated in db below 1 milliwatt by the R.F. ATTENUATOR dial.

Internally synchronized:

Trigger frequency.....120 to 2,000 cycles.

Pulse width.....Continuously variable from 0.75, or less, to 5.75 microseconds (μsec) (at a repetition frequency range of 120 to 2,000 cps).

Phase delay.....Continuously variable. It is possible to phase delay from a minimum of 5μsec to a maximum of 75% of the period between trigger pulses or 1,800 μsec, whichever of the two is smaller.

R-F pulse shape.....The r-f pulse is essentially a square wave with the following characteristics:

a. Rise time: 0.25 (or less) μsec from 10 to 90% maximum.

b. Fall time: 0.7 (or less) μsec from 90 to 10% maximum.

Externally synchronized:

External trigger requirements:

Trigger frequency.....120 to 2,000 cycles.

Width.....0.5 to 18.0 μsec measured at half voltage points.

Polarity.....Either positive or negative.

Amplitude.....From 15 to 100 v. across a load not exceeding 500,000 ohms.

Rise time.....Less than 0.2-μsec rise time to 20 v.

Pulse width.....Same as internally synchronized output.

Phase delay.....Same as internally synchronized output.

R-F pulse shape.....Same as internally synchronized output.

R-F input power measurement....The signal generator measures the r-f power applied to the antenna jack. A wave selector or attenuator must be used so that the peak power does not exceed 300 milliwatts (mw) as a maximum value. With the attenuator set at the red reference mark on the dial, the power measuring meter indicates the average power input up to 200 mw within ±1.5 db of the full-scale value.

5. LIST OF COMPONENTS.

a. Equipment Supplied. The following equipment is contained in the transit case.

Quantity	*Name of unit*	*Dimensions (in.)*				*Unit weight (lb)*
		Height	*Width*	*Depth*	*Length*	
1	Signal Generator TS-155B/UP	9½	16¾	11⅜		34
1	Cord CG-70/MPM (antenna cable)				180	1½
1	Cord CG-71/MPM (trigger cable)				72	11/16
1	Cord CX-145/MPM (trigger cable)				360	1½
1	Adapter UG-131/U	⅝	⅝	1½		1/16
1	Radio Frequency Adapter UG-57/U	¾	¾	2		⅛
1	Crystal Adapter UG-119/UP	¾	¾	2		⅛
1	Radio Frequency Adapter UG-28/U	⅝	1¾	2¾		3/16
1	Tube (crystal) 1N21B (in Crystal Adapter UG-119/UP)					
1	Antenna AT-67/AP	4¼	3¾	2		7/16
1	Allen setscrew wrench No. 8 (in instrument)					
1	Bristow setscrew wrench No. 6 (in instrument)					
1	Transit case (dimension to outside clamps)	12¾	21¾	11¾		23

b. Horn Antenna AT-67/AP. The horn antenna assembly (fig. 2) consists of a cast aluminum housing, the interior surface of which serves as an exponentially flared horn excited by a horizontally polarized one-quarter wave antenna within it. The antenna is formed by an extension of the coaxial center conductor. The antenna is held within the body of the horn by a pre-formed mass of styraloy which completely surrounds it. The unit is watertight when used with a watertight fitting. The characteristics of the antenna are:

(*1*) Broad frequency coverage: 3,750 to 2,400 megacycles per second (mc/s), or 8 to 12.5 centimeters (cm).

(*2*) High gain and directivity: 8 to 9 db, decreasing somewhat at the longer wavelengths.

(*3*) Looking into the coaxial jack, a voltage standing-wave ratio of less than 2.5 over the above band, with a voltage standing-wave ratio of less than 1.5 over the major part of the band. The

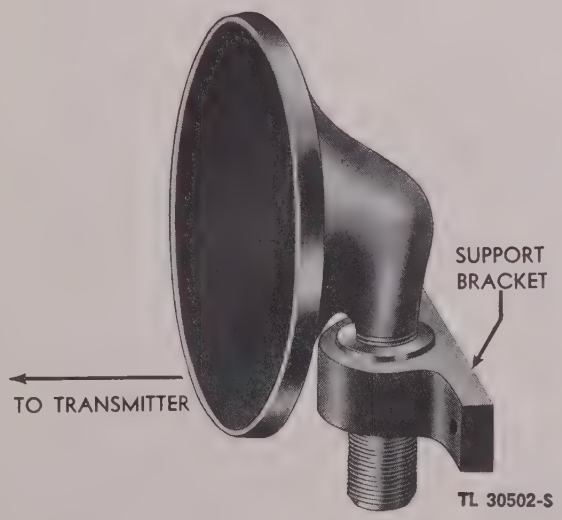


Figure 2. Horn Antenna AT-67/AP.

coaxial line has a jack (Radio Frequency Jack UG-25/U) that fits Radio Frequency Plug UG-24/U.

c. Transit Case. This is a two-compartment metal box with hinged cover and handles. One compartment serves for storing the antenna cable and the two trigger cables. The other compartment, in which the test set is stored, contains a group of cushioning strips mounted on the bottom and sides. The cover contains cushioning pads, which compress slightly on the instrument when the cover is closed, to protect the sides, top, and bottom. These cushions are canvas-covered, moistureproofed, and impregnated against fungus. The transit case contains a compartment for holding this manual, the horn antenna, and the adapters and also provides for storing the running spares listed in the following table.

d. Running Spares. The running spares listed are for initial use only and are not to be requisitioned as a kit or group as shown in this table.

Quantity supplied	*Name of component*	*Required per unit*	*Ref symbols*
1	Thermistor (bead)	1	R57
1	Thermistor (disk)	1	R49
1	Thermistor (disk)	1	R55
2	Panel lamp, 6.3-v, 0.15 amp	1	I1
5	Fuse, 2-amp	1	F1
5	Fuse, 1/32-amp	1	F2
1	Crystal, 1N21B	1	
2	Tube, 6SN7/GT	4	V1, V2, V3, V4
1	Tube, 6AG7	1	V5
1	Tube, 2C40	1	V6
1	Tube, 5Y3/GT	1	V7
1	Tube, VR-150/30	1	V8
1	Tube, VR-105/30	1	V9

e. Tube Complement.

Tube number	*Type*	*Function*
V1 A and B	6SN7/GT	Blocking oscillator, cathode-follower.
V2 A and B	6SN7/GT	Input buffer to delay and pulse multivibrators.
V3 A and B	6SN7/GT	Delay multivibrator.
V4 A and B	6SN7/GT	Pulse multivibrator.
V5	6AG7	Pulse shaper.
V6	2C40	R-F oscillator.
V7	5Y3/GT	Power rectifier.
V8	VR-150/30	Voltage regulator for delay multivibrator.
V9	VR-105/130	Voltage regulator for thermistor bridge.

NOTE: A type 446B or 2C40 tube may be used interchangeably as the r-f oscillator tube in the signal generator.

6. DIFFERENCES IN MODELS.

Signal Generator TS-155B/UP differs from the preceding models, TS-155/UP and TS-155A/UP in the following details:

a. The Aircraft Radio Corporation (ARC) cavity is used.

b. The tuning and attenuator dials are of the drum type, with worm-driven tuning controls.

c. R-F oscillator tubes may be readily replaced without displacing the operating region of the plate tuning shaft.

d. The adjustment of the plunger within the cavity has been simplified; no tools are required.

e. The over-all dimensions and weight of the instrument have been reduced appreciably.

SECTION II

INSTALLATION AND ASSEMBLY OF SIGNAL GENERATOR TS-155B/UP

7. UNPACKING.

The test set should be removed from the transit case before operating.

8. LOCATION OF EQUIPMENT.

The location of the signal generator with respect to the radar set is critical in only one respect; namely, that the signal generator should be positioned *out of the field* of the radar antenna. Two alternative installations are shown: one where a horn antenna is used (fig. 3) and another where a directional coupler is used (fig. 4). These are discussed in the following paragraphs.

9. INSTALLATION WITH HORN ANTENNA (fig. 3).

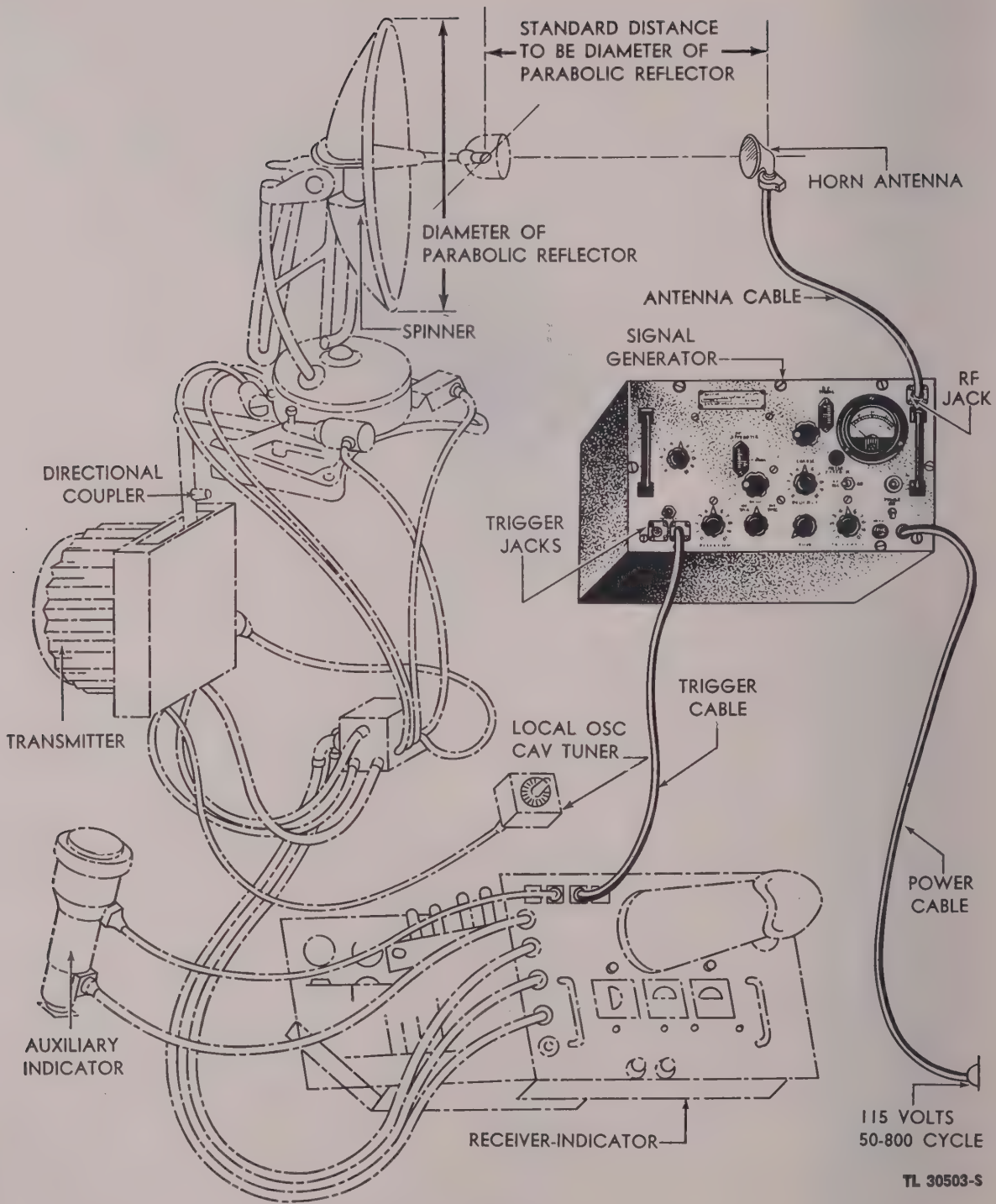
Connect one end of the antenna cable, Cord CG-70/MPM, to the horn antenna assembly, Antenna AT-67/AP, and connect the other end to the R.F. jack on the front panel of the signal generator. It is important that the horn antenna be located at the same distance from the radar antenna in all tests and that it be placed in the center of the radar antenna beam. It should be located as shown in figure 3 and in such a position that the radar antenna, when directed toward the horn antenna, radiates into otherwise free space. The horn antenna should be rigidly mounted by suitable means, using the support bracket with which it is provided. Refer to table I (par. 15c) for horn antenna placements for typical radar sets in order to obtain an approximate known coupling loss as given in table II.

CAUTION: The test set should never be coupled directly into the antenna line of the radar set. If this is done with the radar transmitter operating, damage to the test set is certain to result. The only time that the test set can be directly connected to the radar set is when the radar set has a directional coupler.

10. INSTALLATION WITH DIRECTIONAL COUPLER (fig. 4).

a. Connect one end of the antenna cable, Cord CG-70/MPM, to the jack on the directional coupler of the radar set. Refer to the technical manual of the particular radar set used for any special instructions about the directional coupler.

b. Connect the other end of the antenna cable to the R.F. jack of the signal generator.



The "Standard Distance" referred to above is approximate. More accurate dimensions for specific equipment are listed in Table I.

Figure 3. Signal Generator TS-155B/UP, used with horn antenna.

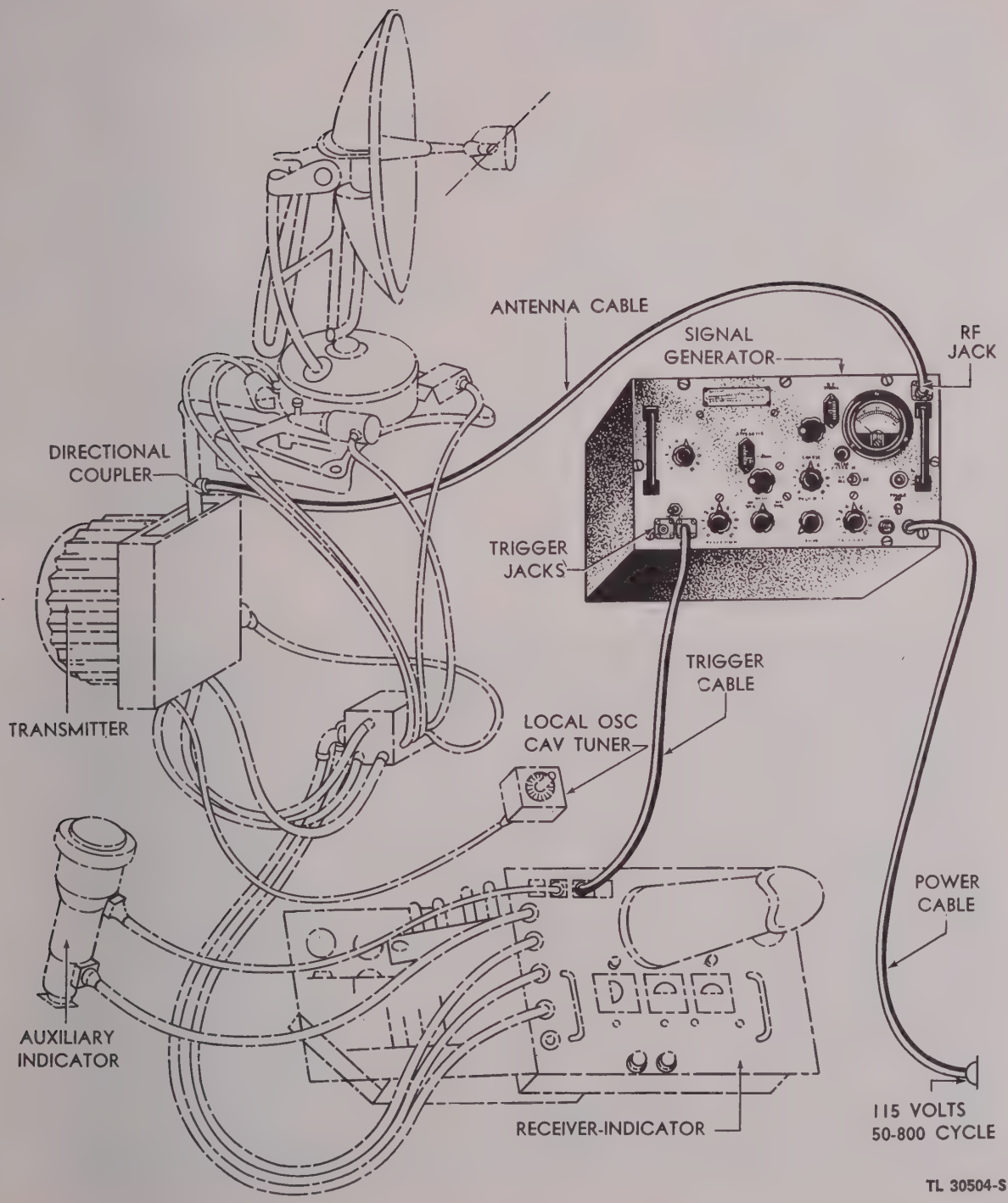


Figure 4. Signal Generator ***TS-155B/UP****, used with directional coupler.*

PART TWO

OPERATING INSTRUCTIONS

SECTION III. PREOPERATIONAL PROCEDURES

11. OPERATING CONTROLS (fig. 5).

The following operating controls are located on the front panel of Signal Generator TS-155B/UP:

a. R. F. Tuning Control (A). A knob which turns a 100-division dial for selecting the frequency.

b. R. F. Attenuator Control (B). A knob which turns an 80-division dial calibrated directly in decibels below 1-milliwatt peak power (−dbm).

c. Pulse Delay Control (C). Two continuously variable controls, one for coarse adjustment and the other for fine adjustment. Refer to figure 6 for an approximate setting of the coarse control when the fine control is set to zero.

d. Output Trig Frequency Control (D). A continuously variable control. Refer to figure 7 for approximate trigger frequency settings.

e. Pulse Width Control (E). A continuously variable control. Refer to figure 8 for approximate pulse width settings.

f. Power Switch (F). A switch for turning on or off the power supplied to the signal generator.

g. Meter Zero Set Control (G). An adjustment control for setting the zero of the power monitoring meter.

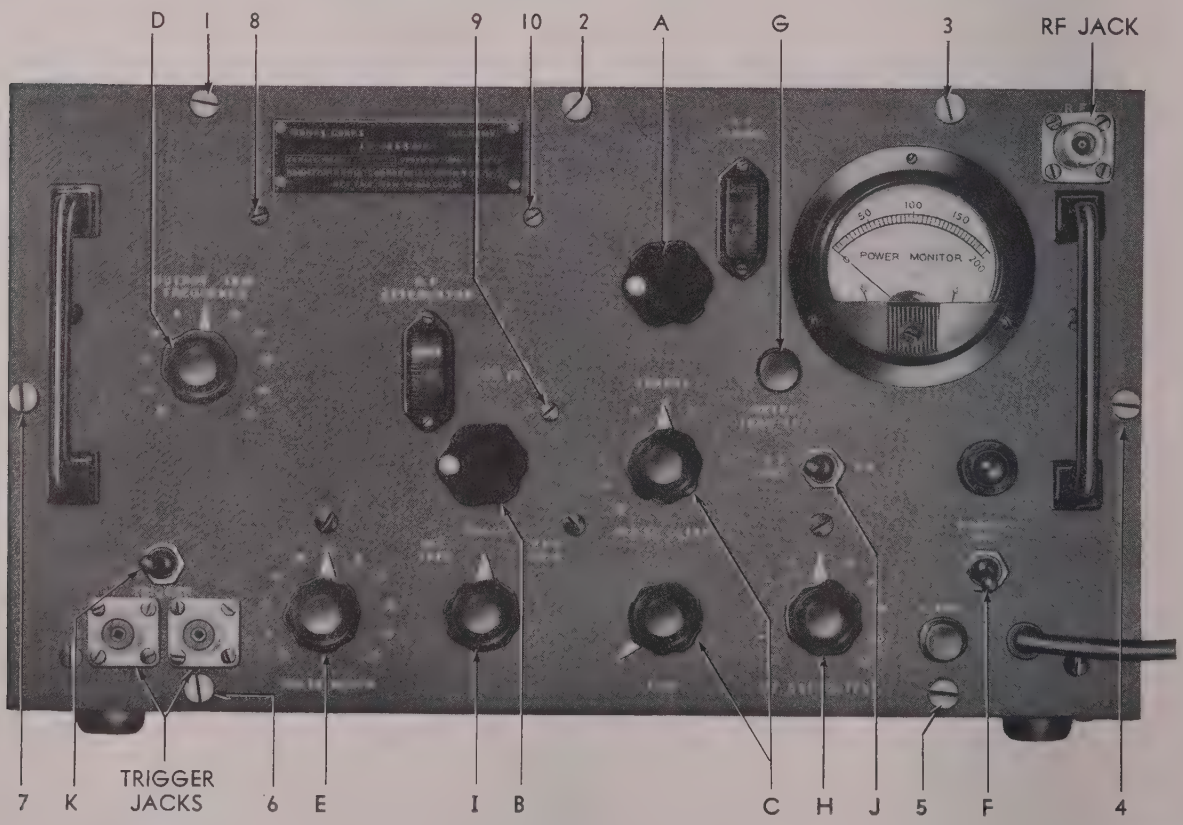


Figure 5. Signal Generator TS-155B/UP, operating controls.

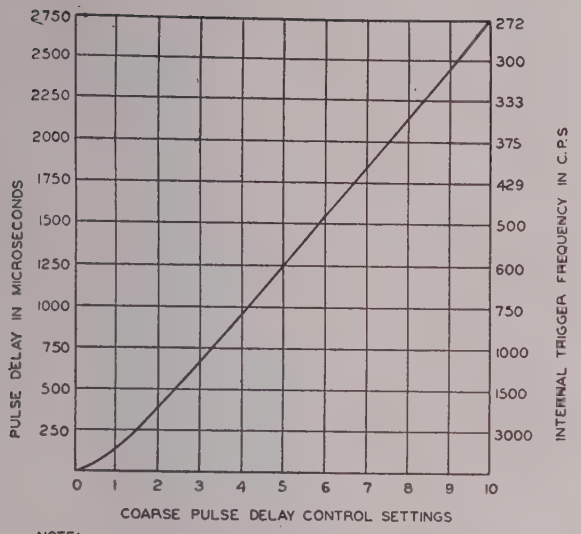

PULSE DELAY IN MICROSECONDS
INTERNAL TRIGGER FREQUENCY IN C.P.S.
COARSE PULSE DELAY CONTROL SETTINGS
NOTE:
IN THIS CURVE IT WILL BE OBSERVED THAT THE PRODUCT OF THE PULSE DELAY IN SEC. AND THE TRIGGER FREQUENCY IN C.P.S. IS A CONSTANT, = 0.75, CORRESPONDING TO 75% OF ONE CYCLE. THE MAX. USEFUL PULSE DELAY IS 75% OF THE TIME BETWEEN PULSES. THEREFORE, FOR A GIVEN TRIGGER FREQUENCY, THE MAX. USEFUL PULSE DELAY IS SHOWN IN μ SEC. ON THE OPPOSITE SIDE OF GRAPH, I.E. 750 μ SEC. AT 1000 C.P.S.
TL 30506-S

Figure 6. COARSE PULSE DELAY control settings.

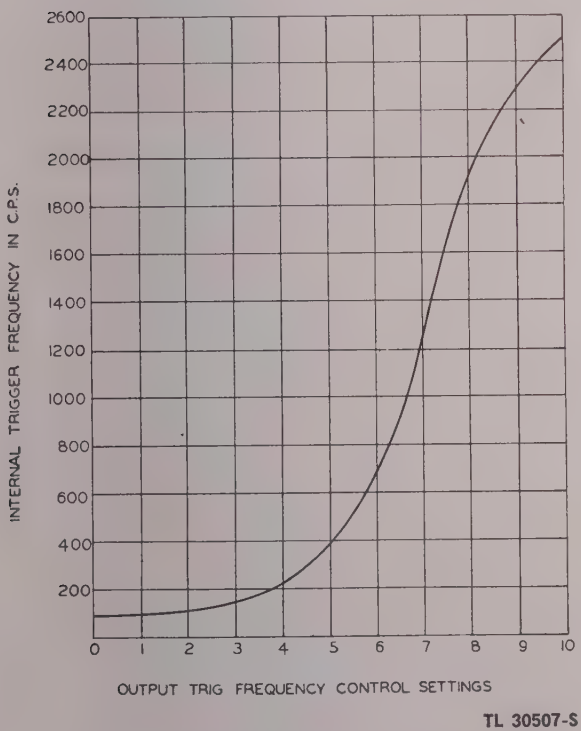


Figure 7. OUTPUT TRIG FREQUENCY control settings.

h. R. F. Osc. Output Control (H). Controls the output power delivered by the cavity oscillator.

i. Int Trig/Calib/Ext Trig Switch (I). Turn this selector switch to INT TRIG when the internal trigger supplied by the signal generator is used for synchronization with the radar set. Turn to CALIB when checking the calibration of the power monitoring meter. Turn to EXT TRIG when the signal generator is synchronized by means of a trigger taken from the radar set.

j. R. F. Osc. Switch (J). For turning on or off the pulse modulating voltage to the cavity oscillator.

k. Input Trigger Switch (K). Switch for selecting the desired trigger polarity, either positive (+) or negative (−).

12. CONNECTIONS.

a. The two TRIGGER jacks (Socket SO-239) are connected in parallel and are used as follows:

(*1*) Selector switch in EXT TRIG position: The external synchronizing voltage is fed in through one of the jacks. The other jack may then be used for synchronizing other equipment with the same external synchronizing voltage.

(*2*) Selector switch in INT TRIG position: The internal synchronizing voltage produced by the

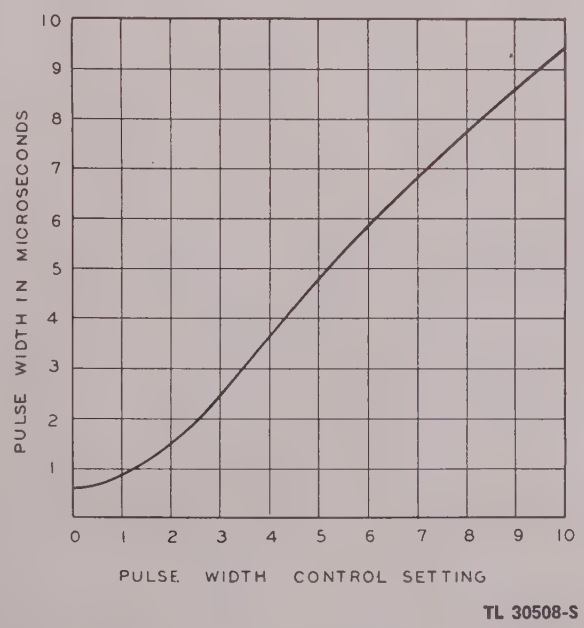


Figure 8. PULSE WIDTH control settings.

signal generator is available at either or both jacks for synchronizing other equipment.

b. The R. F. jack (type N fitting) is used for feeding r-f power into or out of the signal generator.

c. The power cord is secured to the signal generator and plugs into the power source.

13. STARTING PROCEDURE.

a. Connect the power line cable to a source of 50- to 800-cycle, 115-volt power.

b. Turn the POWER switch to ON and the R. F. OSC. switch off. Wait 3 minutes for the signal generator to warm up.

c. Set the R. F. ATTENUATOR between −35 dbm and −40 dbm (set dial between 35 and 40).

d. Adjust the R. F. OSC. OUTPUT control to midposition.

e. Set the selector switch to CALIB.

f. Turn the METER ZERO SET control until the power monitor meter reads zero.

g. Turn the R. F. OSC. switch to ON. The power monitor meter should now indicate the r-f power being generated. If no output is indicated, increase the R. F. OSC. OUTPUT control setting. The amount of power may be varied by the R. F. OSC. OUTPUT control.

SECTION IV. OPERATION

14. SYNCHRONIZATION.

Place the signal generator in operation as described in paragraph 13.

a. External Synchronization. External synchronization is used when testing a radar set that supplies a trigger.

(*1*) Connect one of the jacks marked TRIGGER to any suitable trigger. The IFF trigger of the radar set is usually a convenient one for this purpose.

(*2*) Turn the INPUT TRIGGER polarity switch to + or −, according to the polarity of the trigger used.

(*3*) Turn the selector switch to EXT TRIG.

b. Internal Synchronization. Internal synchronization is used when testing radar sets that can be triggered externally by a positive trigger.

(*1*) Turn selector switch to INT TRIG. The OUTPUT TRIG FREQUENCY control, which has a range of 120 to 2,000 cycles, should be set to the approximate frequency of the radar set being tested (fig. 7). A positive trigger is available at either or both TRIGGER jacks for synchronization of the radar set.

(*2*) Connect a trigger cable between one of the TRIGGER jacks and the appropriate jack on the radar set as specified in the technical manual for the radar set.

15. TESTING OVER-ALL PERFORMANCE OF RADAR SYSTEM.

The testing of a radar set with Signal Generator TS-155B/UP consists of measuring the transmitter power output and receiver sensitivity to determine the over-all performance.

a. Measuring Transmitter Power Output.

(*1*) Place the signal generator in operation as described in paragraph 13.

(*2*) Synchronize either internally or externally as in paragraph 14.

(*3*) Turn R.F. OSC. switch off.

(*4*) Turn the METER ZERO SET knob to adjust the power monitor meter to zero.

(*5*) Connect one end of the antenna cable to the R.F. jack, and the other end either to the horn antenna assembly, type Antenna AT-67/AP (par. 9), or to a directional coupler (par. 10).

(*6*) Turn the radar set on.

(*7*) Turn the R.F. ATTENUATOR knob until the red reference mark is reached. This mark will be found below the lowest calibrations on the dial. When the R.F. ATTENUATOR dial is set to the red mark, the power monitor meter reads directly the number of milliwatts average power input at the R.F. jack.

(*8*) If using a horn antenna, follow subparagraphs (a) and (b) below. If using a directional coupler, omit (a) and (b) and proceed as in subparagraph (9) below.

(*a*) Check installation of the horn antenna assembly to see that it is positioned in the plane of polarization of the radar antenna (fig. 3).

(*b*) Adjust the antenna elevation and azimuth of the radar set for maximum reading of the power monitor meter of the signal generator.

(*9*) Turn the R.F. TUNING knob very slowly from one end of the tuning range to the other, meanwhile watching the power monitor meter. As the radar transmitter frequency is reached, a sharp dip will be observed.

(*10*) Read and record the R.F. TUNING dial scale position at the minimum power monitor meter scale reading.

NOTE: The R.F. TUNING dial has a graduated scale which can be calibrated with an external wavemeter to give a measurement of radar frequency or wavelength within 6 mc or 0.02 cm of the actual value.

(*11*) Turn the R.F. TUNING dial to 0 or 100, whichever is farther away from the reading found in step (10) above. This operation detunes the signal generator cavity from the radar frequency, in order that the cavity will not absorb part of the power.

(*12*) Note the maximum reading on the power monitor meter. This meter reading is the radar transmitter average power output in milliwatts at the signal generator R.F. jack. If the position of the horn antenna is kept constant as described in paragraph 9 or if the same directional coupler is used in all tests, this meter reading will be roughly proportional to the radar transmitter power output. The power monitor of the signal generator serves as an r-f wattmeter and utilizes only a small fraction of the r-f power of the transmitter in measuring its power output.

b. Measuring Receiver Sensitivity. Two procedures for measuring receiver sensitivity are given. Procedure 1 is to be used when the radar receiver has been previously aligned with the transmitter. Procedure 2 is to be used when the receiver is not aligned with the transmitter and there are no simple tune-up procedures available, such as local signals or an echo box with tuning meter. For both cases the procedure is the same except for step (6) where alternative instructions are given.

(*1*) Follow the procedure of subparagraph a.

(*2*) Turn the selector switch to CALIB and adjust the R.F. ATTENUATOR dial to approximately −40 dbm.

(*3*) Turn the R.F. OSC. switch to ON and turn the R.F. OSC. OUTPUT control until the monitor meter reads 200. Set the PULSE DELAY and PULSE WIDTH to the center of their scales.

(*4*) Set the radar range sweep so that a signal at a range of 12 miles (about 22,000 yards) can be seen. Set the selector switch to either INT or EXT as described in paragraph 14.

(*5*) Turn up the R.F. TUNING dial three divisions from the reading found in subparagraph a(10) above.

(*6*) Align the receiver and signal generator to the same frequency by the method described in procedure 1 or 2, whichever applies.

PROCEDURE 1

When the radar receiver has been previously aligned with the transmitter and the radar set is known to be in normal operating condition, proceed as follows:

(*a*) *Tuning Signal Generator to Frequency of Radar Receiver.*

1. Adjust the R.F. TUNING dial within two divisions above or below the value obtained in subparagraph b(5) above, until maximum signal is found on the radar indicator at approximately 12 miles range. If no signal is visible, set the R.F. ATTENUATOR control to the red reference mark and repeat the process.

2. Identify the signal by turning the PULSE DELAY control back and forth about midposition. The signal from the signal generator will move in synchronization with the PULSE DELAY control. Set the PULSE DELAY control so that the signal from the signal generator does not interfere with any other signals.

3. If necessary, increase the R.F. ATTENUATOR dial setting to bring the signal below saturation, and then complete the tuning operation, adjusting the PULSE WIDTH control to give a signal width that appears as wide as a normal echo.

PROCEDURE 2

When the radar receiver is not aligned with the transmitter and no local signal or echo box is available, proceed as follows:

(*b*) *Tuning Radar Receiver to Frequency of Signal Generator.*

1. Set the R.F. ATTENUATOR dial to the calibration reference mark (red line) to provide a large signal.

2. Tune the radar receiver local oscillator until a signal appears on the screen at approximately 12 miles range.

3. Identify the signal by turning the PULSE DELAY control back and forth about mid-position. The signal from the signal generator will move in synchronization with the PULSE DELAY control. Set the PULSE DELAY control so that the signal from the signal generator does not interfere with any other signals.

4. Tune the transmit-receive (T/R) box and the mixer for a maximum signal. If necessary, increase the R.F. ATTENUATOR dial setting to bring the signal below saturation, and then complete the tuning operation.

(*7*) Set the R.F. ATTENUATOR dial to approximately −40 dbm.

(*8*) Turn the R. F. OSC. switch off.

(*9*) Turn the selector switch to CALIB.

(*10*) Readjust the METER ZERO SET control for zero reading of the meter.

(*11*) Turn the R.F. OSC. switch to ON and turn the R.F. OSC. OUTPUT control until the power monitor meter reads 200. This standardizes the signal generator for measuring receiver sensitivity.

(*12*) Turn the selector switch to INT TRIG or EXT TRIG, according to the type of synchronization used.

(*13*) If an A-scope is used, increase the reading of the R.F. ATTENUATOR dial until the signal just disappears in the "grass." If a PPI or B-scope is used, reduce the signal by means of the R.F. ATTENUATOR until it just disappears. The accuracy of this test is improved by moving the signal in range by means of the PULSE DELAY control while attenuating. Record the R.F. ATTENUATOR dial reading. This reading is a relative measure of the sensitivity (expressed in decibels relative to 1 milliwatt) of the radar receiver peak power measured at the R.F. jack of the signal generator. To obtain the absolute sensitivity, the cable and the space attenuation or the attenuation constant of the directional coupler must be known. The greater the R.F. ATTENUATOR dial reading, the greater the receiver sensitivity.

NOTE: If procedure 2 in subparagraph b(6) above is used, the radar set may not be precisely tuned for maximum performance. It may be necessary to retune the radar set slightly, using actual signals or an echo box provided with a tuning meter, to obtain peak performance.

c. Interpretation of Tests.

(*1*) *Using Directional Coupler.* When the radar set being tested has a directional coupler in the r-f plumbing, it is comparatively easy to convert relative power to absolute power at the radar set. The following data and sample calculations will serve as a guide in determining the absolute power.

(*a*) Convert average transmitter power at the signal generator to peak power at the radar transmitter.

1. When the radar set is operating satisfactorily, the average radar transmitter power output will be found as in subparagraph a above, using a directional coupler.

2. Record the meter reading as observed in paragraph 15a(12).

3. Note the attenuation constant of the directional coupler as stamped on the coupler, or refer to table II where values are given for the directional coupler used in various radar sets.

4. Determine the peak power at the radar transmitter, using the following example as an illustration: The average power of the radar set must be determined first. The reading of the monitor meter on the signal generator is 75 mw. The average attenuation of r-f Cord CG-70/MPM is 3 decibels (db). This cable connects the signal generator to the directional coupler of the radar set. The attenuation constant of the directional coupler is found to be 35 db (marked on the coupler).

a. Using figure 9, convert the 75 mw to dbm: the result is 18.8 dbm.

b. Add the cable and directional coupler attenuation to the value in dbm found above. This gives the average transmitted power in dbm (P) in the transmission line. The value found is: P = 18.8 dbm + 3 db + 35 db = 56.8 dbm.

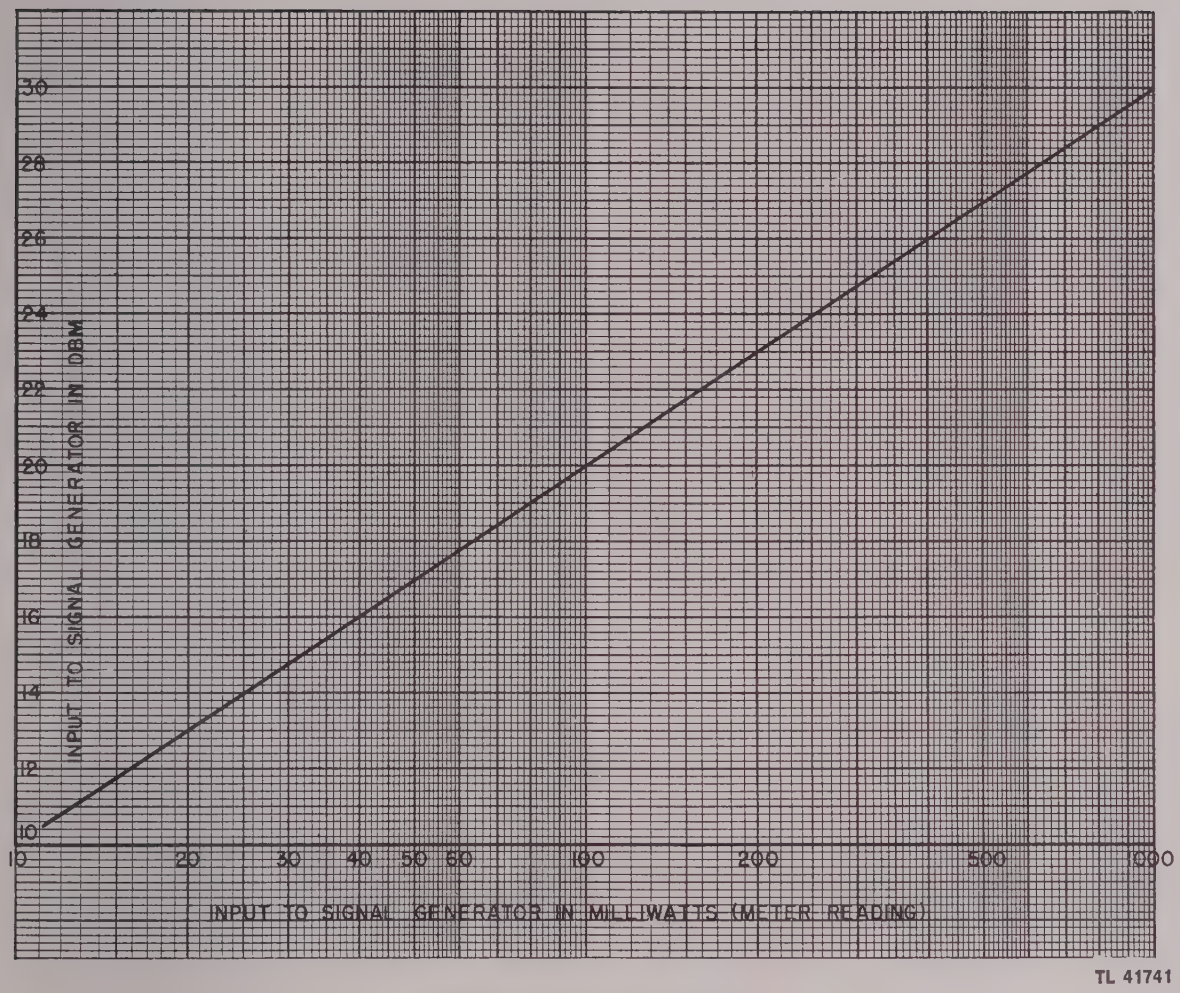


Figure 9. Power conversion chart.

Use the following equation:

$P = M + A_c + A_{dc}$ where

M = reading of monitor meter converted to dbm,

A_c = attenuation of the r-f cable,

A_{dc} = attenuation constant of the directional coupler.

c. The figure just obtained should be compared with an established figure based on the average power rating of the radar transmitter. If it is found that the radar transmitter is down by 2 or 3 db or more, an investigation should be made to determine the cause.

d. The peak power in dbm at the radar transmitter may be determined, if desired by the use of figure 10.

(*b*) Convert relative sensitivity as measured at the test set to actual receiver sensitivity.

1. When a radar set is operating satisfactorily, the receiver sensitivity will be found as in subparagraph b(6), procedure 1.

2. Record the reading of the R.F. ATTENUATOR dial observed in subparagraph b(13). This reading is the peak power output of the signal generator in db below 1 milliwatt.

3. Note the attenuation constant of the directional coupler as stamped on the coupler, or refer to table II where values are given for the directional coupler used in various radar sets.

4. Convert the peak power of the signal generator to minimum discernible signal in the r-f line at the directional coupler by the following equation: $s = -(A_r + C + D)$, where s is the receiver

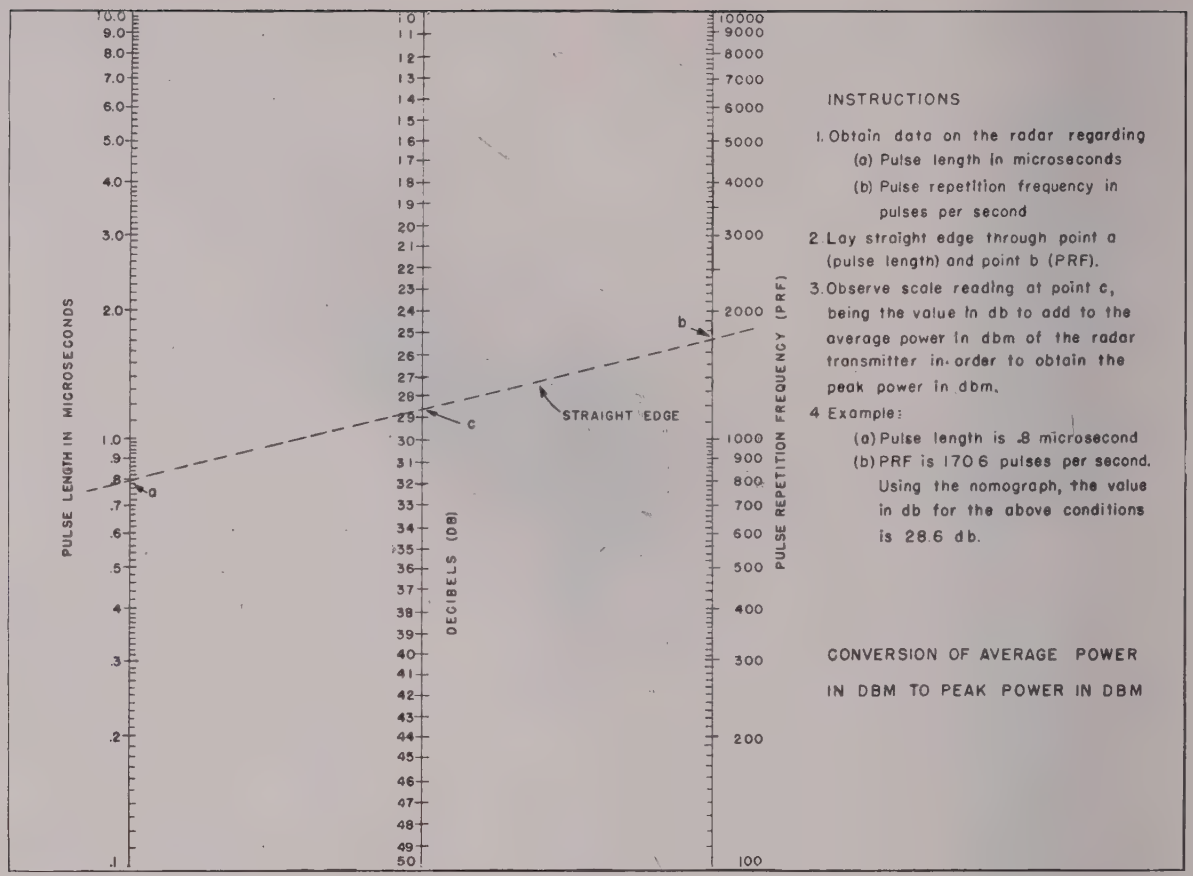

PULSE LENGTH IN MICROSECONDS
DECIBELS (DB)
PULSE REPETITION FREQUENCY (PRF)
STRAIGHT EDGE
a
b
c
INSTRUCTIONS
1. Obtain data on the radar regarding
(a) Pulse length in microseconds
(b) Pulse repetition frequency in pulses per second
2. Lay straight edge through point a (pulse length) and point b (PRF).
3. Observe scale reading at point c, being the value in db to add to the average power in dbm of the radar transmitter in order to obtain the peak power in dbm.
4. Example:
(a) Pulse length is .8 microsecond
(b) PRF is 1706 pulses per second.
Using the nomograph, the value in db for the above conditions is 28.6 db.
CONVERSION OF AVERAGE POWER IN DBM TO PEAK POWER IN DBM
TL 41742

Figure 10. Converting average power to peak power.

sensitivity (minimum discernible signal in the r-f line at the directional coupler in dbm), A_r is the attenuator dial reading in db below 1 mw, C is the attenuation of the r-f cable in db, and D is the attenuation constant of the directional coupler in db.

5. Sample calculation: The reading of the R.F. ATTENUATOR dial on the signal generator is −60 dbm (subpar. b(13) above). The average attenuation of Cord CG-70/MPM is 3 db. The attenuation constant of the directional coupler is 35 db. Using these values, the sensitivity of the receiver is:

$s = -(A_r + C + D) = -60 - 3 - 35 = -98$ dbm.

(2) Using Space Coupling.

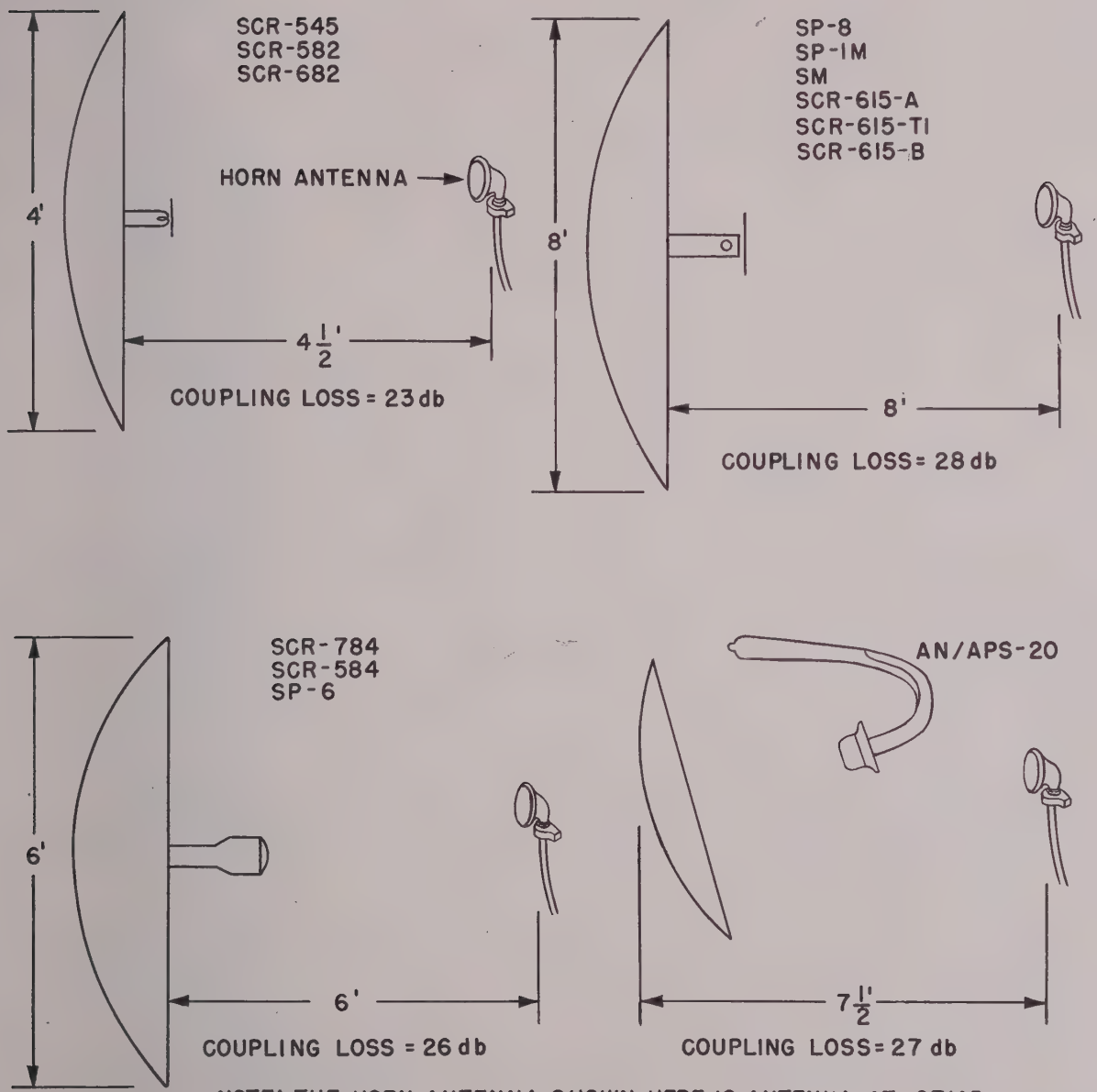
(a) When a radar set without a directional coupler is being tested, a horn antenna is used to pick up the r-f energy. The coupling loss for a definite spacing between the radar antenna dipole and the horn antenna is indicated for various radar sets in table I. The spacing indicated in the table must be strictly adhered to; otherwise the coupling loss given will not be the correct one.

(b) The average transmitter power at the signal generator may be converted to peak power at the radar transmitter in the manner described in subparagraph (1) (a) above. Where the attenuation of the directional coupler is mentioned in subparagraph (1), substitute the figure for the coupling loss indicated in table II. The coupling loss given in table II for the space coupling method is defined as the combined loss of the radar antenna gain, space loss, and horn antenna gain.

(c) The relative sensitivity measured at the signal generator may be converted to actual receiver sensitivity in the manner described in subparagraph (1) (b) above. Where the attenuation constant of the directional coupler is mentioned in subparagraph (1) substitute the figure for the coupling loss indicated in table II.

TABLE I

HORN ANTENNA PLACEMENT FOR TYPICAL RADAR SETS



(3) *Determination of Changes in Over-all Performance.*

(*a*) By combining the transmitter and receiver performance data obtained during a regular check with similar data taken during the following day or another periodic check, a determination may be made of any change in over-all performance that has taken place. The change in performance may be expressed in db and may be converted to loss of effective range.

TABLE II

COUPLING LOSS FOR TYPICAL RADAR SETS

Radar set	*Coupling loss* using Antenna AT-67/AP (db)*	*Attenuation constant of directional coupler used in radar set (db)*
AN/APS-20	27	35
AN/CPS-4		35
AN/CPS-6		
SP-6	26	33
SP-8		
SP-1M	28	33
SM		
SCR-545	23	30
SCR-582	23	23
SCR-584	26	34
SCR-784		
SCR-615-A	28	33
SCR-615-T1		
SCR-615-B	28	35
SCR-682	23	26

* The coupling loss indicated here is the combined value of the radar antenna gain, space loss, and horn antenna gain. The value given here is approximately correct, providing the distance between the horn antenna and the radar antenna is adhered to as given in table I.

NOTE: It is essential that the measuring technique used in the initial measurement and in subsequent periodic checks be identical. If the horn antenna installation was used in the initial case, then all following checks should be made with the horn antenna situated to agree as closely as possible with the original placement in regard to distance from radar antenna, orientation, etc.

(*b*) In the equations given (subpars. (1)(a)4b and (1)(b)4) substitute the values determined in the initial check and in the following check. In the example worked out below, P_1 and S_1 are the values of the initial power output and receiver sensitivity, and P_2 and S_2 are the values obtained in the following hypothetical periodic check. For example: if

TABLE III

RADAR RANGE VS RADAR PERFORMANCE

Performance down in db	*Percentage of total effective range*
0	100%
−1.5	92%
−3	84%
−5	75%
−10	56%
−15	42%
−20	32%
−25	24%
−30	18%
−35	13%
−40	10%
−45	7.5%
−50	6.0%

$P_1 = 56.8$ dbm and $P_2 = 51.8$ dbm, the power output of the radar transmitter is down 5 db. If $S_1 = -98$ dbm and $S_2 = -93$ dbm, then $S_1 - S_2 = -98 - (-93) = -98 + 93 = -5$ db. Hence the radar receiver sensitivity is down 5 db.

(*c*) To determine the resulting effective range of the radar set, add the db values of both the transmitter and receiver, thus:

Transmitter	−5 db
Receiver	−5 db
Over-all	−10 db

Referring to table III, it is evident that a system which is down in performance by 10 db will have a maximum range which is roughly 56 percent of the normal range.

(*4*) *Explanation of Table III.*

(*a*) When the radar transmitter power output is standard, the radar set range is called normal or 100 percent. If the power output or the receiver sensitivity or both are below standard, the range obtainable with the radar set decreases to the percentage of normal range shown in table III.

(*b*) This table is based on the inverse fourth power law which applies to aircraft radar and ground or ship radar when used in searching for aircraft at high angles. The change in radar range as a function of radar performance differs somewhat from this table for low-angle searching, particularly over water.

PART THREE

PREVENTIVE MAINTENANCE

SECTION V. PREVENTIVE MAINTENANCE TECHNIQUES

16. MEANING OF PREVENTIVE MAINTENANCE.

Preventive maintenance is a series of operations performed at regular intervals on equipment, when turned off, to eliminate major break-downs and unwanted interruptions in service and to keep the equipment operating at top efficiency. To understand what is meant by preventive maintenance, it is necessary to distinguish preventive maintenance from trouble shooting and repair. The prime function of preventive maintenance is to *prevent* breakdowns and, therefore, the need for repair. On the other hand, the prime function of trouble shooting and repair is to locate and correct *existing* defects. The importance of preventive maintenance cannot be overemphasized. The satisfactory operation of a radar set depends upon its readiness and operating efficiency when it is needed. The test equipment by which condition of readiness is realized must therefore be kept in excellent operating condition at all times.

17. DESCRIPTION OF PREVENTIVE MAINTENANCE TECHNIQUES.

a. General. Most of the electrical parts used in Signal Generator TS-155B/UP require routine preventive maintenance. Those requiring maintenance differ in the amount and kind required. Because hit-or-miss techniques cannot be applied, definite and specific instructions are needed. This section of the manual contains these specific instructions and serves as a guide for personnel assigned to perform the six basic maintenance operations, namely: Feel, Inspect, Tighten, Clean, Adjust, and Lubricate. Throughout this manual the lettering system for the six operations will be as follows:

F—Feel*
I—Inspect
T—Tighten
C—Clean
A—Adjust
L—Lubricate

The Inspect operation establishes the need for the others. The selection of operations is based on a general knowledge of field needs. For example, the dust encountered on dirt roads during cross-country travel filters into the equipment no matter how much care is taken to prevent it. Rapid changes in weather (such as heavy rain followed by blistering heat), excessive dampness, snow, and ice tend to cause corrosion of exposed surfaces and parts. Without frequent inspections and the necessary performance of tightening, cleaning, and lubricating operations, equipment becomes undependable and may break down when it is most needed.

b. Inspect. Inspection is the most important operation in the preventive maintenance program. A careless observer will overlook the evidences of minor trouble. Although these defects may not interfere with the performance of the equipment, valuable time and effort can be saved if they are corrected before they lead to major break-downs. Make every effort to become thoroughly familiar with the indications of normal functioning in order to be able to recognize the signs of a defective set. Inspect for the following conditions:

(*1*) Overheating, as indicated by discoloration, blistering, or bulging of the parts or surface of the container; leakage of insulating compounds; and oxidation of metal contact surfaces.

*The Feel operation is inapplicable to Signal Generator TS-155B/UP.

(*2*) Improper placement, by observing whether all leads are in their original positions.

(*3*) Lack of cleanliness, by carefully examining all recesses in the units for accumulation of dust, especially between connecting terminals. Parts, connections, and joints should be free of dust, corrosion, and other foreign matter. In tropical and high-humidity locations, look for fungus growth and mildew.

(*4*) Looseness, by testing any connection or mounting which appears to be loose.

c. Tighten, Clean, and Adjust. These operations are self-explanatory. Specific procedures to be followed in performing them are given wherever necessary throughout this part of the manual.

CAUTION: Screws, bolts, and nuts should not be tightened carelessly. Fittings tightened beyond the pressure for which they are designed will be damaged or broken. Whenever a loose connection is tightened, it should be moistureproofed and fungiproofed again by applying the varnish with a small brush.

d. Lubricate. Lubrication refers to the application of grease or oil to the bearings of motors or other rotating shafts. It may also mean the application of a light oil to door hinges or other sliding surfaces on the equipment.

SECTION VI. ITEMIZED PREVENTIVE MAINTENANCE

18. INTRODUCTION.

In this section the preventive maintenance work to be performed on the test set at specified time intervals is broken down into units of work called *items*. The specified intervals at which each item is to be performed are scheduled in the check list in paragraph 26.

19. COMMON MATERIALS NEEDED.

The following materials will be needed in performing preventive maintenance:

Common hand tools.
Clean cloth.
#0000 sandpaper.
Crocus cloth.
Solvent, Dry-cleaning, Federal Specification P-S-661a.

NOTE: Gasoline will not be used as a cleaning fluid for any purpose. Solvent, Dry-cleaning, Federal Specification P-S-661a, is available as a cleaning fluid through established supply channels. Oil, Fuel, Diesel, US Army Specification 2-102B, may be used for cleaning purposes when dry-cleaning solvent is not at hand.

20. ITEM 1—EXTERIOR OF SIGNAL GENERATOR TS-155B/UP.

a. Preliminary Step. Remove the signal generator from the transit case.

b. Inspect. Inspect the exterior of the signal generator for dust, dirt, and corrosion. Check the power cable for rubber deterioration, excess wear, cuts, and kinks. Replace the cable if necessary. Give special attention to the R.F. and TRIGGER jacks. If the meter glass is cracked, replace the glass or repair it temporarily with friction tape. Be sure the 2-AMP fuse is inserted properly. Check all control knobs for looseness.

c. Tighten. Tighten any loose control knobs; be sure not to disturb their calibration.

d. Clean. Clean R.F. jack, TRIGGER jacks, and power plug with a cloth or, if necessary, with crocus cloth. Remove grease and oil from the power cable with a soft cloth dampened with dry-cleaning solvent. Clean the meter glass. Remove grease and dirt from the exterior of the signal generator with a cloth, moistened with dry-cleaning solvent if necessary. Touch up the exterior of the signal generator with paint if necessary.

21. ITEM 2—TOP OF CHASSIS (fig. 11).

a. Preliminary Steps.

(*1*) Remove the chassis from the cover by loosening the seven captive screws on the front panel.

(*2*) Discharge the high-voltage capacitors before performing any of the following steps.

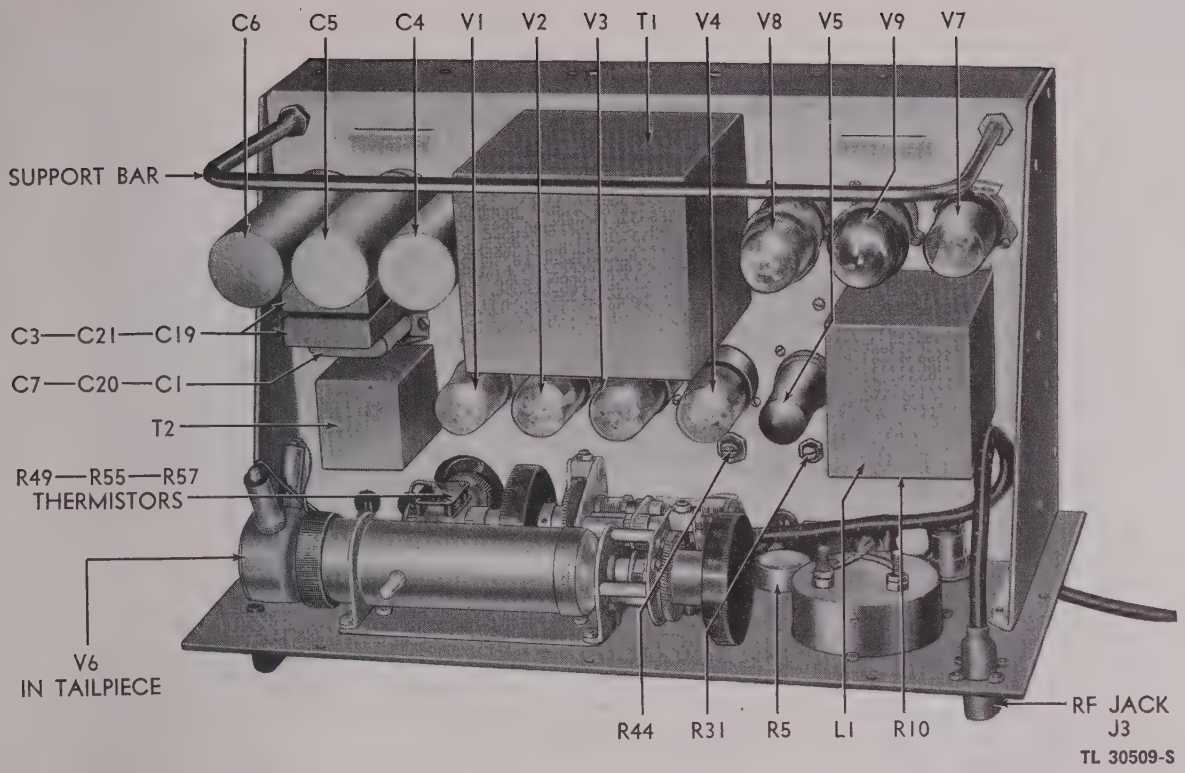


Figure 11. Top of chassis.

b. Inspect. The entire top of the chassis for cleanliness. Check all nuts, screws, and bolts for tightness. Check for firmness of the tubes in their sockets. Do *not* partially withdraw them by rocking them from side to side in their sockets. Inspect tubes by pressing them firmly into their sockets and test them in that position. Check the transformer and choke for signs of overheating. The high-voltage capacitors should be checked for bulges. Check all electrical connections. Inspect the attenuator and tuning gears for wear and excess lubrication.

c. Tighten. All loose mounting nuts and bolts. The r-f output cable connector must be tight. Be sure all tube clamps are fastened properly.

d. Clean. Clean the entire top of the chassis. Remove the dust and dirt on the tubes with a clean dry cloth. Clean the exterior of the cavity and attenuator. Use care in cleaning the thermistor bridge assembly. Clean the r-f tuning and r-f attenuator gears, if necessary. The cavity should not be disassembled for routine preventive maintenance. Repair of the cavity and instructions for disassembly are given in part five.

e. Lubricate. Apply a few drops of Oil, Engine, US Army Spec No. 2–104B, to the r-f attenuator and r-f tuning gears after they have been thoroughly cleaned.

22. ITEM 3—BOTTOM OF CHASSIS (fig. 12).

a. Preliminary Steps.

(*1*) Remove the chassis from the cover by loosening the seven captive screws on the front panel.

(*2*) Discharge the high-voltage capacitors before performing any of the following steps.

b. Inspect. The bottom of the chassis and all parts for cleanliness. Inspect all mounting bolts for tightness. Inspect the tube socket connections for tightness and good soldering. All electrical connections must be tight; soldered connections must be mechanically and electrically sound. Inspect the transformer bushings for cracks and dirt. Inspect all resistor and capacitor boards for dirt and defective parts. Look for burned-out resistors. Inspect the contacts of switch S2. Check the ferrule resistor for discoloration or other signs of possible trouble. Replace any resistors showing signs of possible failure.

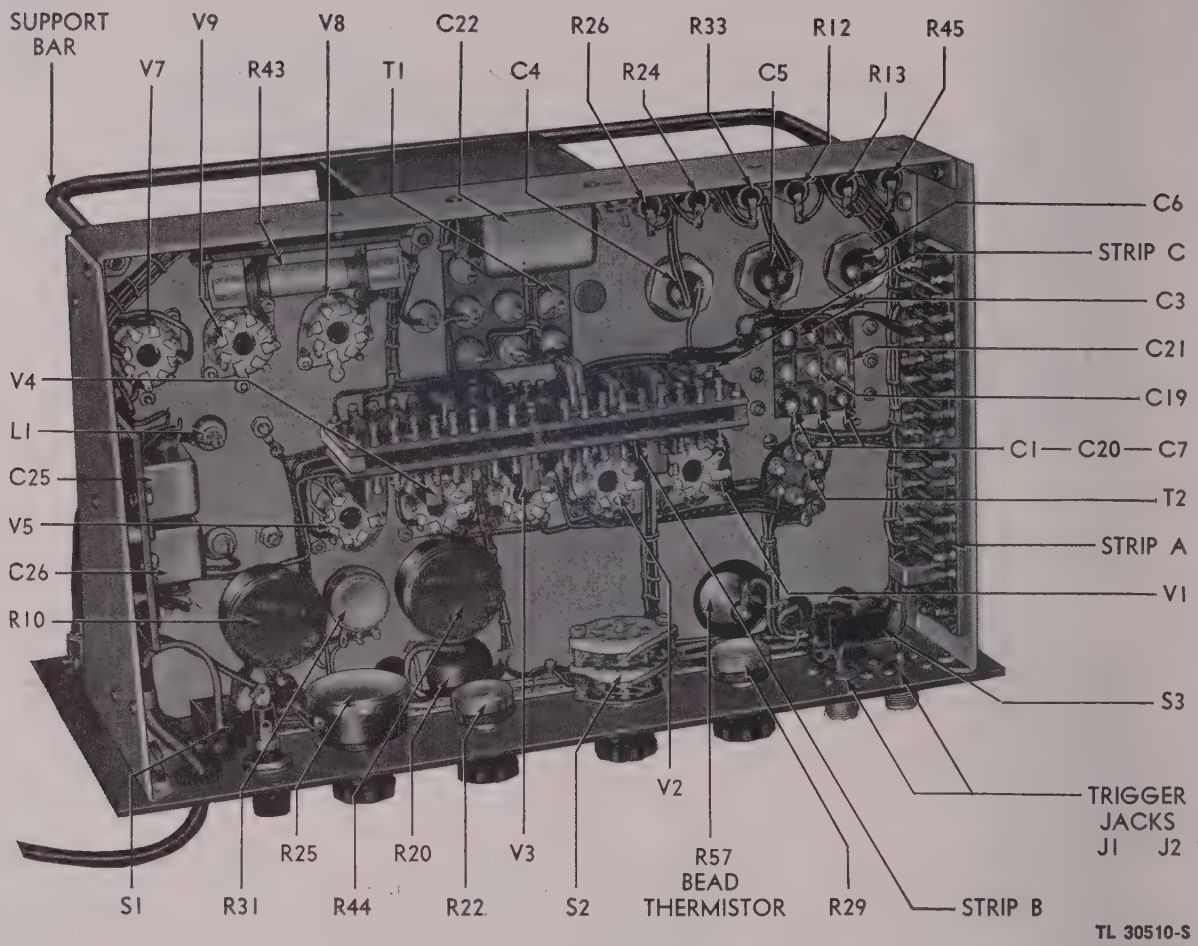


Figure 12. Bottom of chassis.

c. Tighten. Tighten all mounting screws and screw-type terminals.

d. Clean. Clean the entire bottom of the chassis. Pay particular attention to the transformer bushings. Clean the contacts of switch S2 with crocus cloth or fine sandpaper. Be sure to clean the switch carefully after surfacing the contacts.

e. Adjust. The position of the wiring and r-f output cable. Carefully adjust the contacts of switch S2 if they are out of line.

23. ITEM 4—CORDS CG-70/MPM, CG-71/MPM, AND CX-145/MPM.

a. Inspect. Inspect the cables for deterioration, excess wear, cuts, and kinks. Inspect the plugs on each end.

b. Clean. Remove grease and oil from the cables with a cloth dampened with cleaning solvent. Clean the plugs with a dry cloth or, if necessary, with fine sandpaper or crocus cloth.

24. ITEM 5—ANTENNA AT-67/AP.

a. Inspect. Inspect the horn antenna for damaged parts.

b. Clean. Clean with a clean cloth.

25. ITEM 6—TRANSIT CASE.

Clean dirt and grease from the transit case if necessary.

26. PREVENTIVE MAINTENANCE CHECK LIST.

The following check list is a summary of the preventive maintenance to be performed on Signal Generator TS-155B/UP. The suggested time intervals shown on the check list may be varied at any time by the person in charge. However, for best performance of the equipment, perform the operations at least as frequently as specified in the check list.

Item No.	*Operations*	*Description of item*	*When performed*			
			Daily	*Weekly*	*Monthly*	*Semi-annually*
1	ITC	Exterior of Signal Generator TS-155B/UP.	X			
2	ITCL	Top of chassis.			X	
3	ITCA	Bottom of chassis.			X	
4	IC	Antenna cable, Cord CG-70/MPM, and trigger cables, Cords CG-71/MPM and CX-145/MPM.		X		
5	IC	Horn antenna assembly, Antenna AT-67/AP.		X		
6	C	Transit case.		X		

F	I	T	C	A	L
Feel*	Inspect	Tighten	Clean	Adjust	Lubricate

* The Feel operation is inapplicable to Signal Generator TS-155B/UP.

SECTION VII. LUBRICATION

27. LUBRICATION INFORMATION.

The only lubrication required is covered in section VI, paragraph 21e.

SECTION VIII. MOISTUREPROOFING AND FUNGIPROOFING

28. GENERAL.

When operated in tropical areas where temperature and relative humidity are extremely high, Signal Corps equipment requires special attention. These are some of the problems met:

a. Resistors, capacitors, coils, chokes, transformer windings, etc., fail because of the effects of fungus growth and excessive moisture.

b. Electrolytic action, often visible in the form of corrosion, takes place in resistors, coils, chokes, transformer windings, etc., causing eventual breakdown.

c. Hook-up wire insulation and cable insulation break down. Fungus growth accelerates deterioration.

d. Moisture forms electrical leakage paths on terminal boards and insulation strips, causing flash-overs.

e. Moisture provides leakage paths between battery terminals.

29. TREATMENT.

A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant varnish applied with a spray gun or brush. Refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish spray method of moistureproofing and fungiproofing and the supplies and equipment required in this treatment.

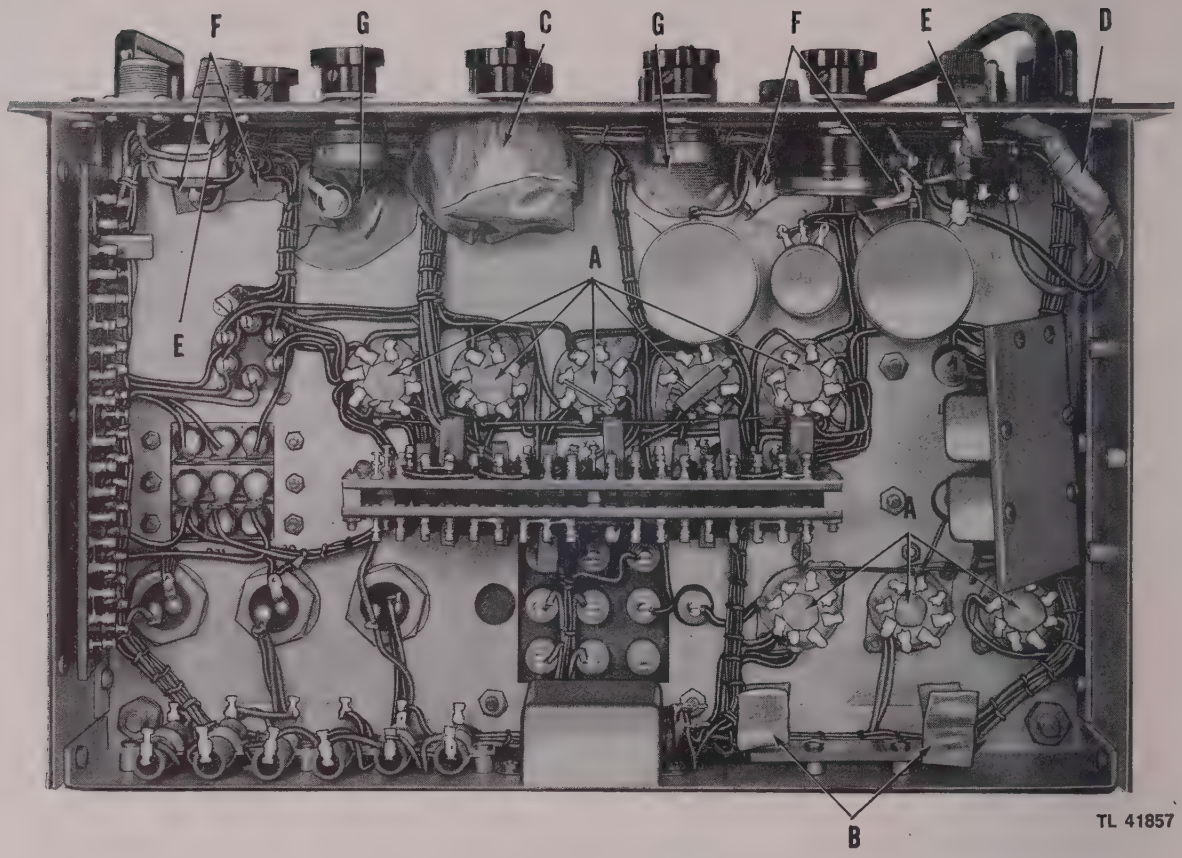


Figure 13. Bottom view of chassis, masking points.

CAUTION: Varnish spray may have poisonous effects if inhaled. To avoid inhaling spray, use respirator if available; otherwise, fasten cheesecloth or other cloth material over nose and mouth. Never spray varnish or lacquer near an open flame. Do not smoke in a room where varnish or lacquer is being sprayed. The spray may be highly explosive.

30. STEP-BY-STEP INSTRUCTIONS FOR TREATING SIGNAL GENERATOR TS-155B/UP.

a. Preparation. Make all repairs and adjustments necessary for proper operation of the equipment.

b. Disassembly.

(*1*) Loosen the seven slotted thumbscrews on the edges of the front panel.

(*2*) Slide the chassis from the case.

(*3*) Remove two nuts, mark leads for reassembly, disconnect the leads from the terminals on the rear of the power monitor meter, and replace the nuts.

(*4*) Remove the three screws and nuts which mount the meter on the front panel.

(*5*) Remove the five screws which hold the phenolic terminal board on the left under side of the chassis. Pull the board gently away from the chassis as far as the wiring will permit.

(*6*) Remove the five screws from the terminal board on the right under side of the chassis.

(*7*) Remove the clip-type resistor on the under side of the chassis.

(*8*) On the under side, lift the wiring away from the chassis.

(*9*) Loosen the tube clamps on the top of the chassis, and remove the tubes.

c. Cleaning. Clean all dirt, dust, rust, and fungus from the equipment to be processed. Clean all oil and grease from the surface to be varnished.

d. Masking (figs. 13 through 17).

(*1*) On the under side of the chassis, mask the following:

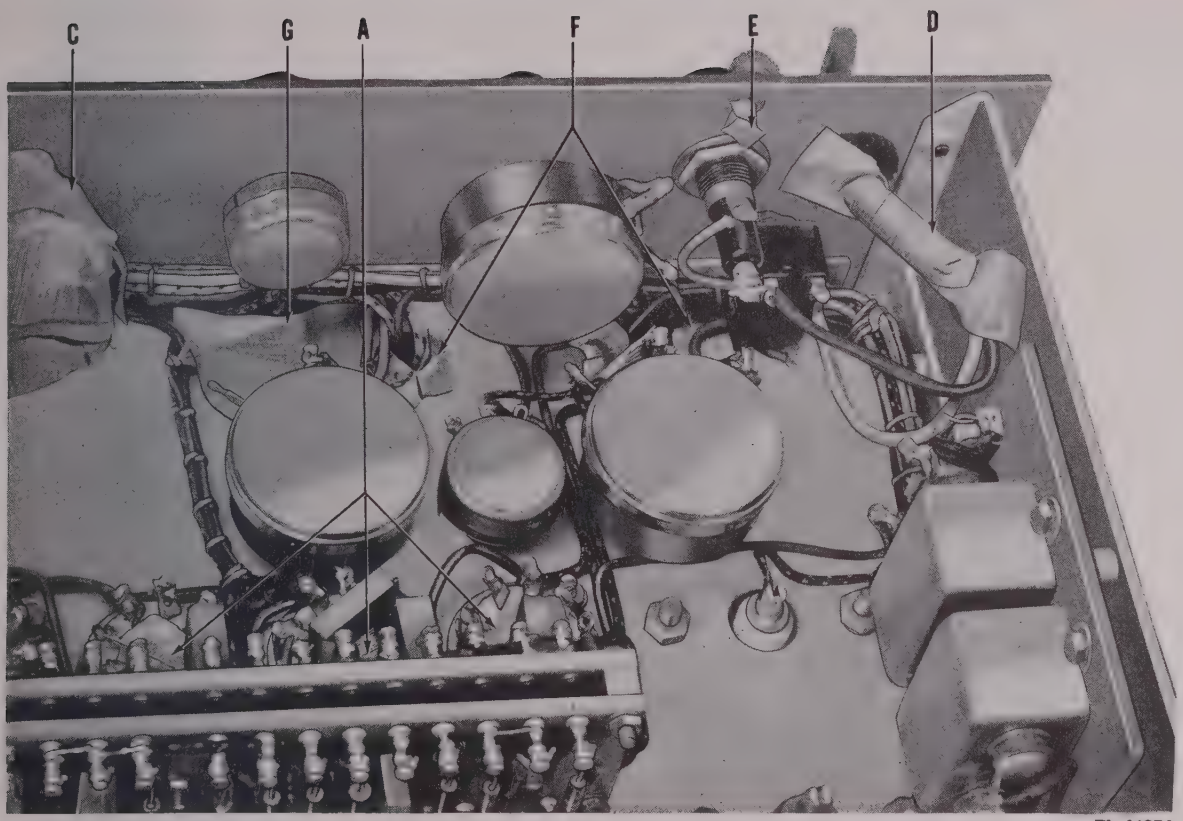


Figure 14. Bottom view of chassis, right side, masking points.

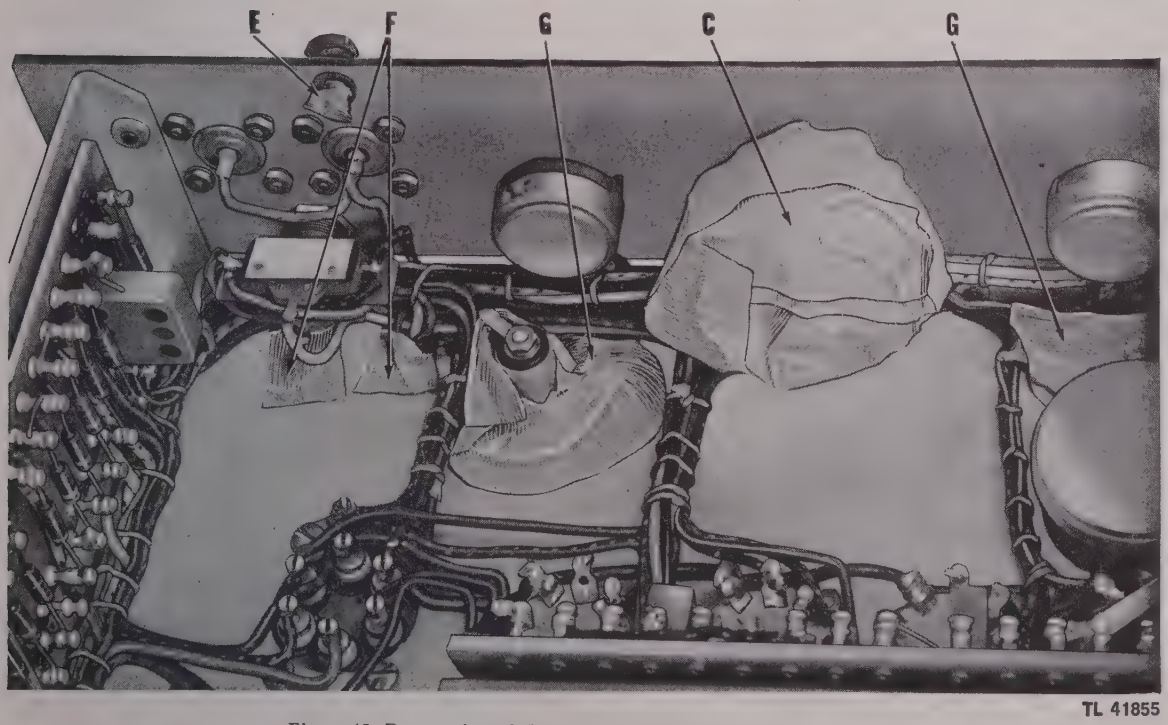


Figure 15. Bottom view of chassis, left front corner, masking points.

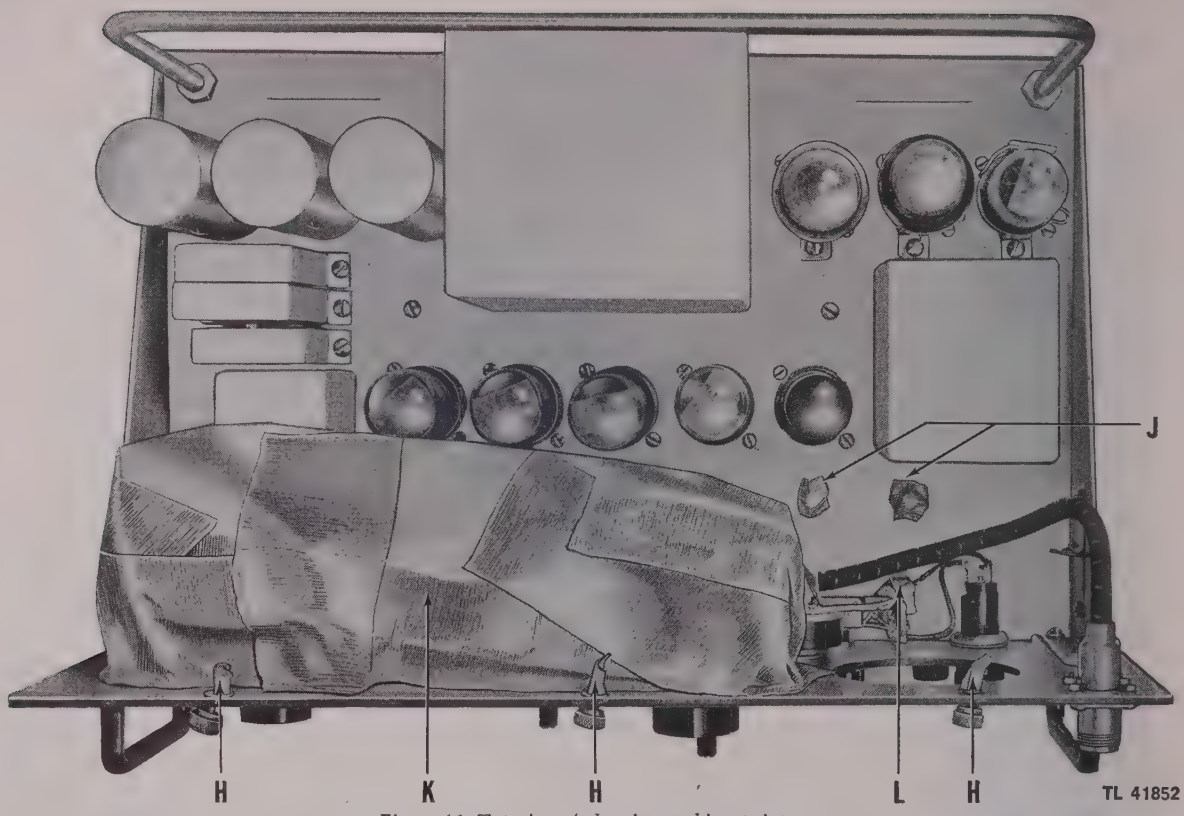


Figure 16. Top view of chassis, masking points.

(*a*) Holes in the bases of the eight vacuum-tube sockets (A).

(*b*) Clips for resistor R42 (B).

(*c*) Selector switch (mounted on the front panel) (C).

(*d*) Rubber-covered power cable inside of chassis (D).

(*e*) Threads on threaded mounting screws, on front panel (E).

(*f*) The four rubber grommets (F).

(*g*) Holes, in the chassis, through which gearing in top side of chassis may be seen (G).

(*2*) On the top of the chassis, mask the following:

(*a*) Threads of the threaded mounting screws of the front panel (H).

(*b*) Terminals of the meter leads (I).

(*c*) Slotted potentiometer-adjustment shafts (J).

(*d*) The complete tuning cavity subassembly on the rear of the front panel (K).

(*e*) The rubber grommets (L).

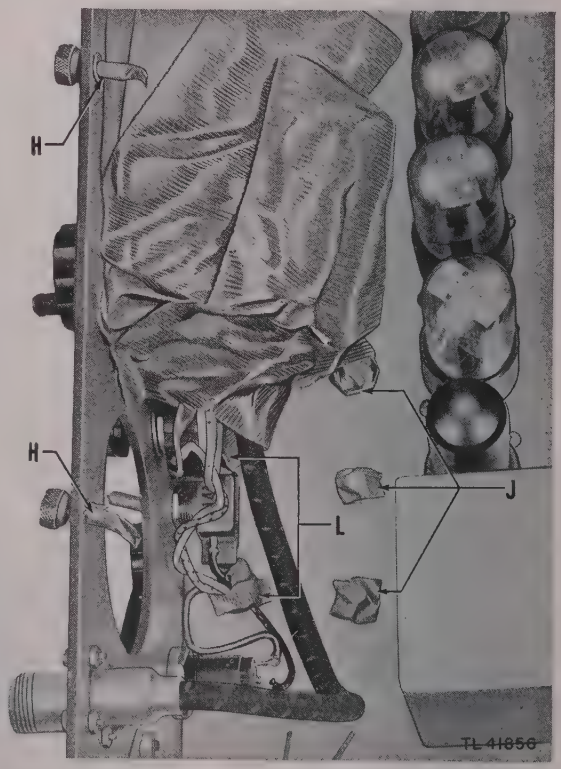


Figure 17. Top view of chassis, left front corner, masking points.

e. Drying. Place the equipment in an oven or under heat lamps and dry for 6 hours at 140° F.

f. Varnishing.

(*1*) Apply three coats of moistureproofing and fungiproofing varnish (Lacquer, Fungus-resistant, Spec No. 71-2202, stock No. 6G1005.3, or equal). Allow each coat to dry for 15 or 20 minutes at temperature specified in subparagraph e above before applying the next coat.

(*2*) Apply varnish immediately after the equipment is dried. If varnish is not applied immediately, moisture condenses on the equipment. Varnish applied over the moisture peels off readily after the varnish has dried.

(*3*) Spray the top, under side, and rear of the chassis.

(*4*) Brush-coat the bakelite case of the power monitor meter.

g. Reassembly.

(*1*) Remove all masking tape; be careful not to peel varnish from near-by areas.

(*2*) Touch up with a brush where necessary.

(*3*) Clean and burnish all contacts.

(*4*) Reassemble the unit and test its operation.

h. Marking. Mark the letters MFP and the date of treatment on the control panel of the signal generator.

EXAMPLE: MFP—4 Apr 45.

31. MOISTUREPROOFING AND FUNGIPROOFING AFTER REPAIRS.

If, during repair, the coating of the protective varnish has been punctured or broken, and if complete treatment is not needed to reseal the equipment, supply a brush-coat to the affected part. Be sure the break is sealed completely.

PART FOUR

AUXILIARY EQUIPMENT

(*NOT USED*)

PART FIVE

REPAIR INSTRUCTIONS

NOTE: Failure or unsatisfactory performance of equipment used by Army Ground Forces and Army Service forces will be reported on W. D., A. G. O. Form No. 468 (Unsatisfactory Equipment Report) (fig. 38); by Army Air Forces, on Army Air Forces Form No. 54 (Unsatisfactory Report).

SECTION IX. THEORY OF OPERATION

32. GENERAL DESCRIPTION.

a. Mechanical.

(*1*) The structure of Signal Generator TS-155B/UP consists of a typical radio chassis on which all circuit parts are mounted. It is conventional except for the cavity and its associated parts. These are easily accessible for replacement. The chassis is secured to the front panel, and the unit slides into a dust cover or protective box where it is held by means of seven captive screws (1 to 7 inclusive) as shown in figure 5. The support bar shown in figures 11 and 12 allows the chassis to be inverted and placed on a bench for inspection of the components.

(*2*) The cavity and its associated parts are made up of the following principal sections.

(*a*) Cavity.
(*b*) Thermistor monitoring system.
(*c*) Attenuator.

b. Electrical. The simplified block diagram (fig. 18) shows the relationship between the principal component circuits. With the exception of the power supply, these parts and their functions are as follows:

(*1*) *Blocking Oscillator* provides a signal at the desired repetition rate for triggering the signal generator internally.

(*2*) *Trigger Inverter* takes a positive or negative external signal and applies it to the delay multivibrator with proper polarity for triggering the signal generator from an external source.

(*3*) *Delay Multivibrator* is triggered by a signal from either the trigger inverter or the blocking oscillator; provides a square or rectangular pulse, the length of which determines the time delay between the triggering signal and the final r-f pulse.

(*4*) *Differentiator and Buffer* converts the trailing edge of the delay multivibrator pulse into a signal for triggering the pulse multivibrator.

(*5*) *Pulse Multivibrator* when triggered, provides a pulse of desired duration for keying the cavity oscillator.

(*6*) *Driver* shapes the pulse developed in the pulse multivibrator so that it may properly key or modulate the cavity oscillator.

(*7*) *Cavity Oscillator* when keyed or modulated, provides the r-f power.

(*8*) *Thermistor Bridge* measures r-f power passing through the r-f attenuator.

(*9*) *R-F Attenuator* controls the output power from the cavity oscillator; also used to pass power from an external source to the thermistor bridge for measurement.

(*10*) *Power Supply* furnishes power to energize the circuits.

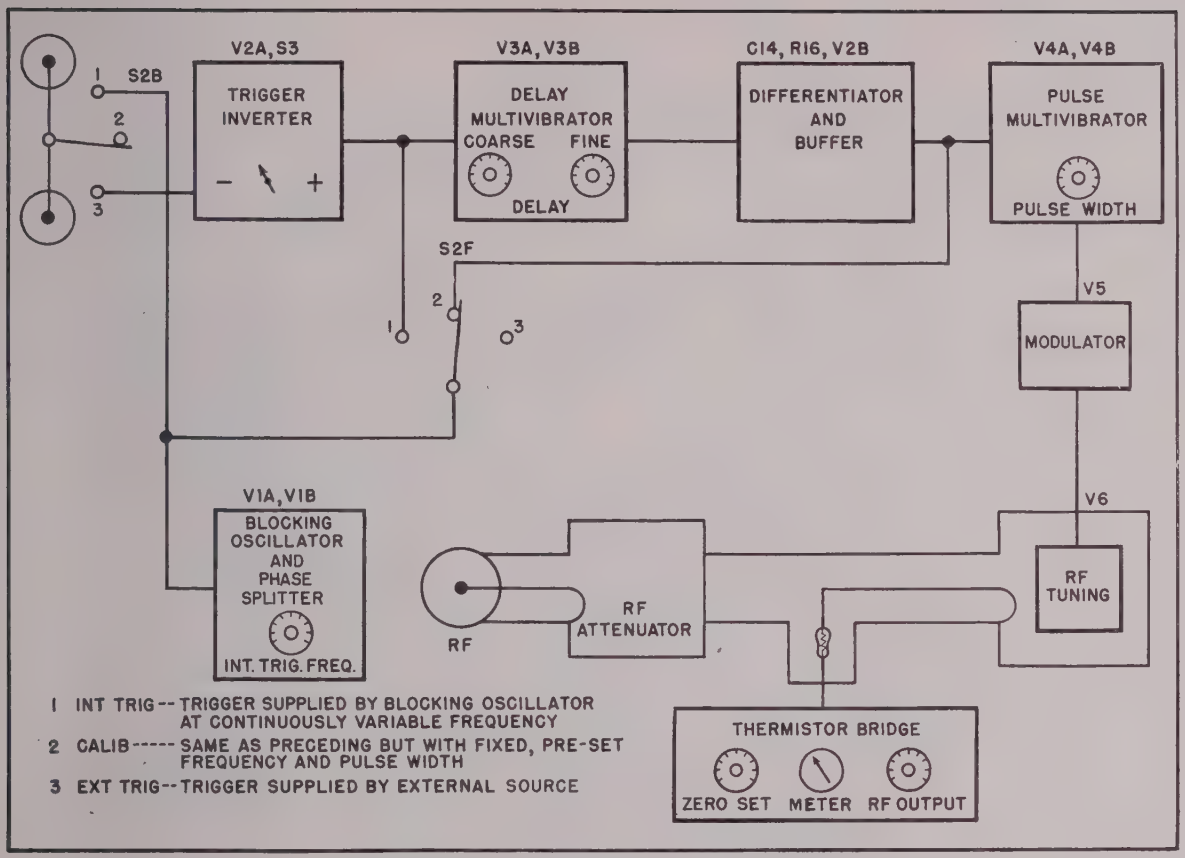


Figure 18. Signal Generator TS-155B/UP, block diagram.

33. DESCRIPTION OF MECHANISM OF CAVITY AND ASSOCIATED PARTS.

The principal parts of this complete assembly are the cavity proper, the thermistor monitoring system, and the attenuator. These parts are interconnected and mounted on a plate, forming a subassembly which may be removed as a unit from the chassis. Figure 19 shows the complete cavity as a unit. Figure 20 is a cutaway view of the ARC type of cavity. In this drawing each part is identified by a number which is referred to in the following descriptive text. The identifying numbers used in figures 19 and 20 are not related to the numbers used in other drawings in this book.

a. Cavity. The cavity proper consists of a silver-plated brass tube containing the following principal parts (figs. 19 and 20).

(*1*) The removable tailpiece (53) supports the cathode and filament r-f chokes (54), the tube socket (51), and the r-f oscillator tube (50). Provision has been made for a limited sliding action of the tube socket, at right angles to the axis of the cavity, but movement of the tube socket along the axis is prevented. This design permits the physical alignment of a structurally imperfect (with eccentric elements) r-f oscillator tube within the cavity. The r-f oscillator tubes vary in height, and correction for this variation is obtained by adjusting the position of the tailpiece (53) within the cavity. The tailpiece is clamped securely in place within the cavity by the clamping nut (52) which, when tightened, presses a ring of contact fingers, which are part of the cavity proper, upon the tailpiece. Instructions for replacing r-f oscillator tubes are given in paragraph 44a.

(*2*) The ring of cathode contacting fingers (49) contact the cathode ring of the r-f oscillator tube and form one end of the oscillator portion of the cavity proper.

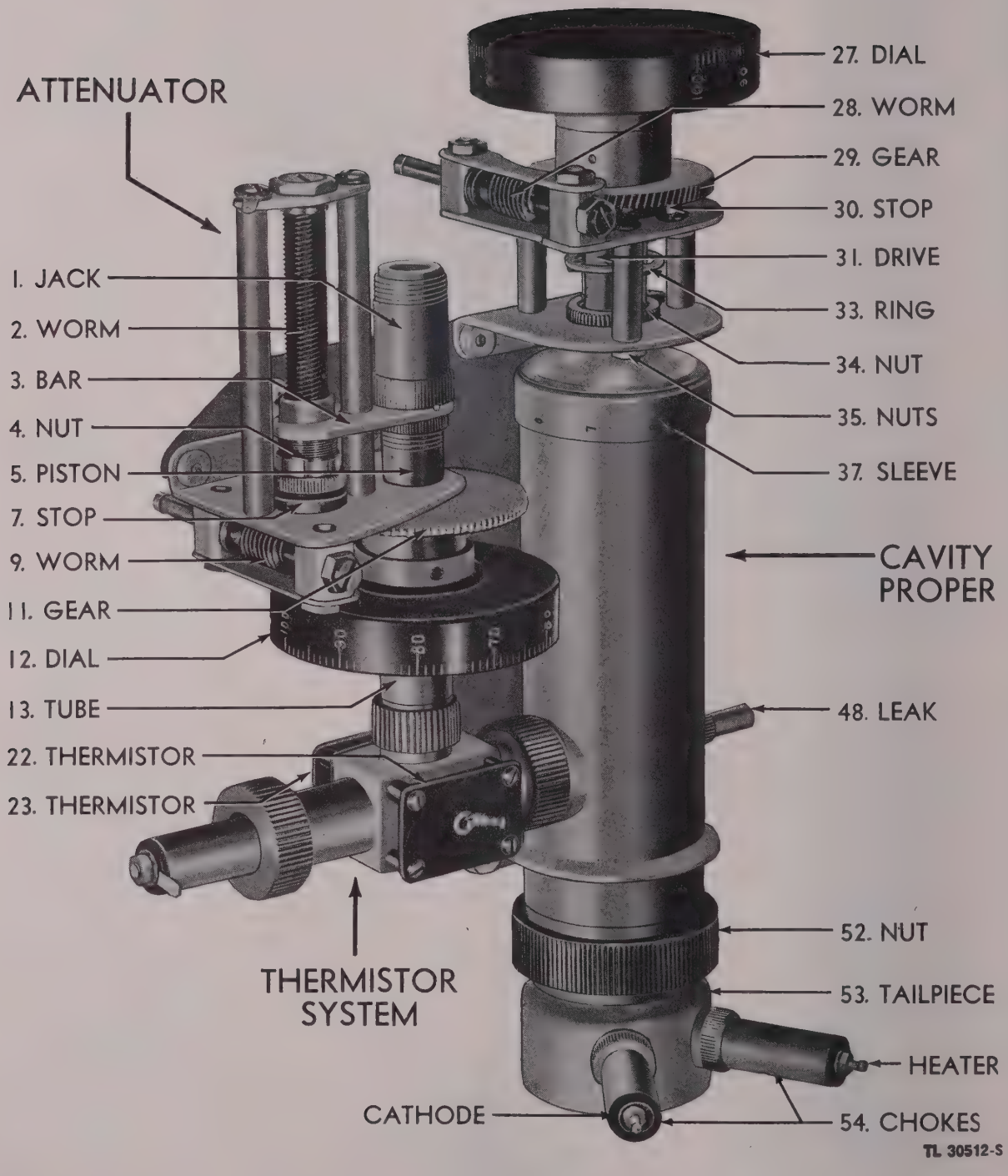


Figure 19. Cavity for Signal Generator TS-155B/UP, external view.

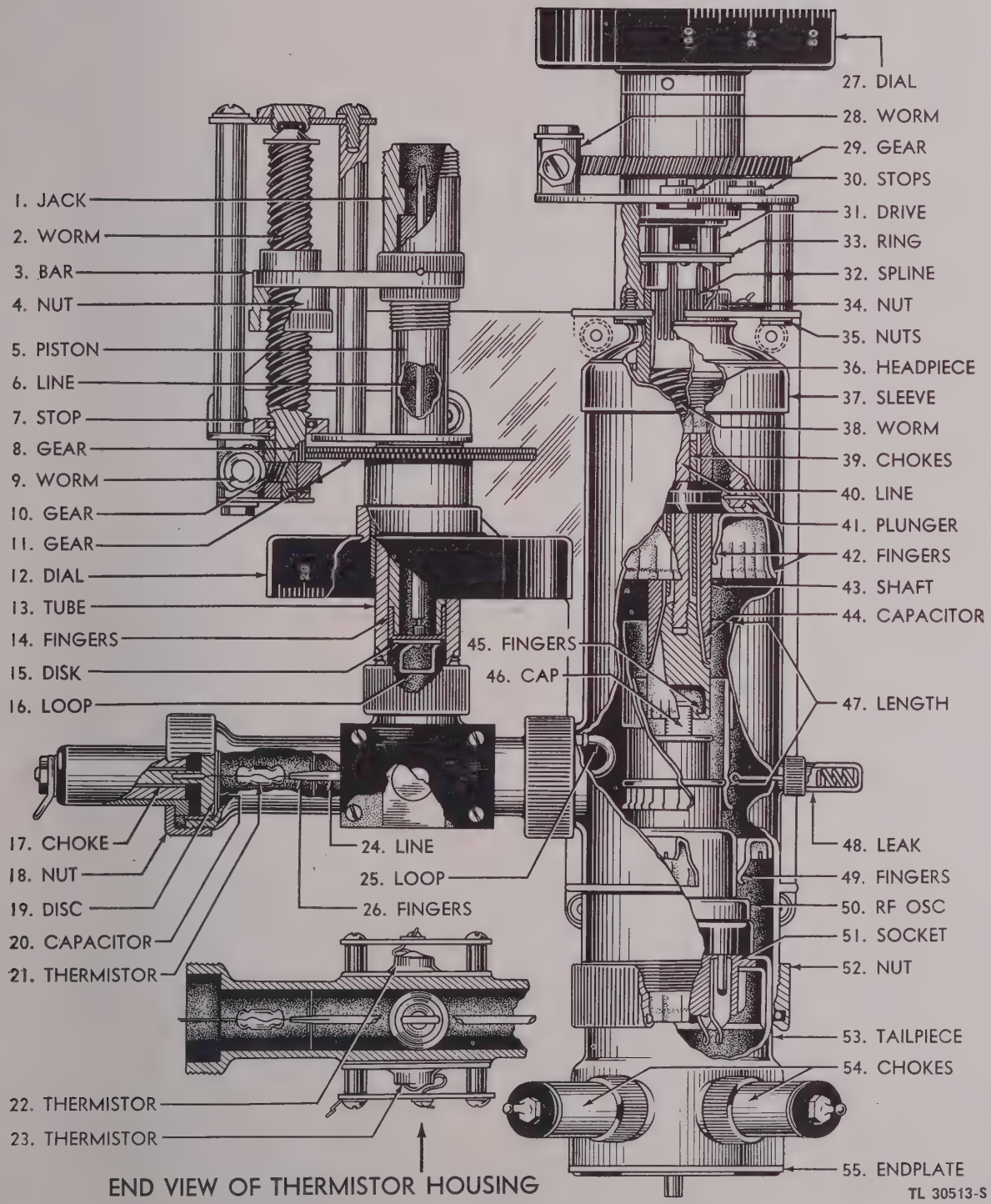


Figure 20. Cavity for Signal Generator TS-155B/UP, cutaway view.

(*3*) The grid cylinder sleeve assembly (47) is made up of an inner cylinder with flexible fingers which slip over the grid ring of the r-f oscillator tube and an outer cylinder which slides over and grips the inner cylinder. The length (47) of this assembly may be adjusted for optimum operating conditions. The grid leak (48) is contained within a metal housing which threads in a boss in the cavity proper. When so located the grid leak contacts the grid cylinder sleeve assembly.

(*4*) The adjustable plunger (41) forms the other end of the oscillator portion of the cavity proper. It consists of a support block to which is secured a double set of contact fingers (42) which contact both the inner wall of the cavity proper and the plate tuning shaft (43). The position of the plunger within the cavity may be varied by means of the sleeve (37) which fits over the outer surface of the cavity. When the sleeve is manually rotated, the plunger is propelled linearly within the cavity by an internal gear and screw mechanism. The outer surface of the sleeve (37) is roughly calibrated in terms of the position of the plunger within the cavity proper. The sleeve may be rotated through four turns, moving the plunger about $\frac{7}{16}$ inch. Instructions for adjusting the plunger for optimum operating conditions are given in paragraph 45a.

(*5*) Continuous tuning over a prescribed frequency band is possible by moving the plate cap fingers (45) over the plate cap (46) of the r-f oscillator tube (50). When the tuning knob on the front panel (fig. 5) is turned, the worm (28) is turned and rotates the gear (29). The gear (29) is secured to the spline driver (31), which fits over the spline shaft (32). The spline shaft (32), the worm (38), the plate shaft (43), and the plate cap fingers (45) are integral and form the plate tuning shaft. Hence when gear (29) is rotated, the spline drive (31) is rotated and the worm (38) is rotated. The worm (38) threads into the headpiece (36) and when rotated produces a linear and rotary motion of the plate tuning shaft and moves the plate cap fingers spirally over the plate cap of the r-f oscillator tube. As the shaft moves, the spline slides under the spline drive. The stops (30) limit the rotary motion to approximately 270°. Since the worm (38) has a pitch of 4 threads per inch, the linear travel of the plate tuning shaft is approximately $\frac{3}{16}$ inch. The graduated tuning dial (27) is secured by means of setscrews to a hub on the spline drive.

(*6*) The B+ voltage is applied to the plate of the r-f oscillator tube through a brush which contacts the collector ring (33), thence through the B+ line (40) and the plate cap finger unit (45). The rf is filtered from the B+ line by the r-f bypass capacitor (44) and the r-f chokes (39). Both the end of the plate cap finger unit (45) and the end of the plate tuning shaft, into which it fits, are conical. A cone of mica separates and insulates these pieces and forms an r-f bypass capacitor. The B+ line is a brass shaft which passes through the hollow plate tuning shaft. It joins the plate cap finger unit to the collector ring. Polyiron cores fit over the B+ line and serve as r-f chokes.

b. Thermistor Monitoring System. The principal parts are the thermistor coupling loop (25), the connecting line (24), the bead thermistor (21), the r-f bypass capacitor (20), the r-f choke (17), the two disk thermistors (22, 23), and the housing which contains these parts.

(*1*) R-F power is taken from the cavity for the thermistor monitoring system by the thermistor coupling loop (25) which penetrates the cavity proper. The extension of this loop becomes the thermistor line (24) and ends in the split fingers (26) which clamp one lead of the bead thermistor (21). The other lead of the bead thermistor is inserted through a hole in the center of a small brass disk which, in conjunction with a mica disk, serves as an r-f bypass capacitor (20). The conical end of a brass rod fits over the small brass disk. An r-f choke (17) is contained in the upper section of the thermistor housing.

(*2*) The r-f power is monitored by the change in resistance of the bead thermistor caused by the r-f current passing through and heating it. The two disk thermistors are used to compensate for changes in resistance of the bead thermistor and monitoring meter due to ambient temperature changes. The disk thermistors are mounted externally on the thermistor housing. In the absence of r-f monitoring current passing through the bead thermistor, the disk thermistors and the bead thermistor are at substantially the same temperature. The design of the thermistor bridge system is discussed in paragraph 35h. One of the disk thermistors is insulated by a thin mica sheet from the thermistor housing. Instructions for replacing the bead thermistor are given in paragraph 44b.

c. Attenuator. The principal parts of the attenuator are the attenuator tube (13), the piston (5), and the drive mechanism.

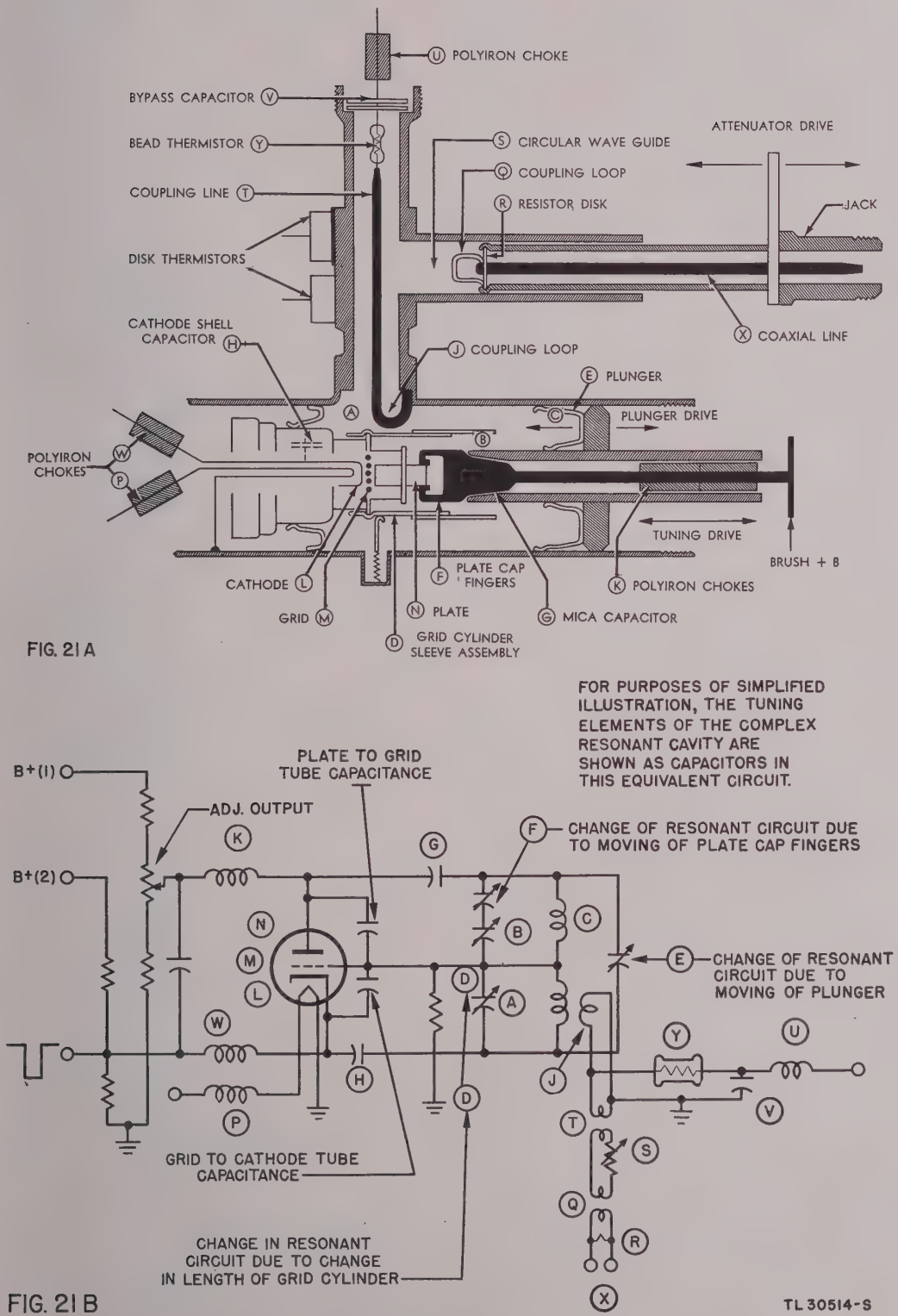

U POLYIRON CHOKE
BYPASS CAPACITOR V
BEAD THERMISTOR Y
COUPLING LINE T
DISK THERMISTORS
CATHODE SHELL CAPACITOR H
S CIRCULAR WAVE GUIDE
Q COUPLING LOOP
R RESISTOR DISK
ATTENUATOR DRIVE
JACK
X COAXIAL LINE
J COUPLING LOOP
E PLUNGER
PLUNGER DRIVE
POLYIRON CHOKES W P
TUNING DRIVE
BRUSH + B
CATHODE L
GRID M
F PLATE CAP FINGERS
N PLATE
D GRID CYLINDER SLEEVE ASSEMBLY
G MICA CAPACITOR
K POLYIRON CHOKES
FIG. 21 A
FOR PURPOSES OF SIMPLIFIED ILLUSTRATION, THE TUNING ELEMENTS OF THE COMPLEX RESONANT CAVITY ARE SHOWN AS CAPACITORS IN THIS EQUIVALENT CIRCUIT.
B+(1)
B+(2)
PLATE TO GRID TUBE CAPACITANCE
ADJ. OUTPUT
F CHANGE OF RESONANT CIRCUIT DUE TO MOVING OF PLATE CAP FINGERS
E CHANGE OF RESONANT CIRCUIT DUE TO MOVING OF PLUNGER
GRID TO CATHODE TUBE CAPACITANCE
CHANGE IN RESONANT CIRCUIT DUE TO CHANGE IN LENGTH OF GRID CYLINDER
FIG. 21 B
TL 30514-S

Figure 21. Equivalent circuit of cavity.

(*1*) *Attenuator Tube.* This is a silver tube which is secured to the thermistor housing by a clamping nut. Silver is used to insure good conductivity through the contact fingers (14) of the piston. The attenuator tube serves to guide the piston and to support the attenuator dial and its drive mechanism.

(*2*) *Piston* (*5*). The piston travels within the attenuator tube and consists of a close-fitting silver-plated brass tube with a ring of contact fingers (14), a coupling loop (16), a resistor disk (15), a connecting line (6), and a jack (1). The contact fingers slide along the inner wall of the attenuator tube. The coupling loop couples to the thermistor line (24) and transmits r-f power through the attenuator line (6), which is an insulated brass rod, to the jack (1). The resistor disk (15) consists of a thin bakelite disk which has been sprayed on one surface with a resistive material. Narrow rings of silver have been deposited around its outer edge and around the edge of the center hole. One end of the attenuator loop is connected to the center of the resistor disk. The outer edge of the resistor disk is secured to the end of the attenuator piston. The function of the resistor disk is to terminate the attenuator transmission line in its proper impedance.

(*3*) *Drive Mechanism.* When the attenuator control on the front panel (fig. 5) is turned, the worm shaft (2) is rotated by means of worm 9 and gear 10. The bar (3) threads on the worm shaft (2) and is connected to the piston (5) at the jack (1). The piston is thus propelled linearly within the attenuator tube by means of the bar (3). The attenuator dial (12) is driven by gear 8 and gear 11. Nut 4 is adjustable and limits the maximum coupling between the attenuator coupling loop and the thermistor line. The jack (1) is connected by a flexible cable to the r-f jack on the front panel. Since the r-f power in the thermistor line is monitored by the thermistor bridge system, the attenuator dial may be calibrated, and a known r-f power will be delivered to the proper impedance at the r-f jack on the front panel.

CAUTION: The stopnut (4) is factory-adjusted and locked in position and should not be changed, because this would affect the calibration of the attenuator.

34. ANALOGY OF CAVITY OSCILLATOR TO LUMPED CIRCUIT OSCILLATOR (fig. 21).

a. The oscillator circuit consists of the type 446B or 2C40 tube elements and the resonant cavity in which the tube is mounted. If the resonant cavity is considered to be composed of three coaxial line cavity parts, A, B, and C as shown in figure 21A, it can be compared to a somewhat analagous lumped constant circuit shown in figure 21-B. This type of resonant cavity provides large feedback between the plate-to-grid region and the grid-to-cathode region, with the result that oscillations build up quickly at the beginning of each pulse.

b. The components shown in the diagram (fig. 21-A) can be compared to the lumped constant circuit (fig. 21-B) by referring to the corresponding circled identification letters on the illustrations.

c. The r-f tuning control (F) changes the frequency by moving the plate cap fingers along the plate cap of the 446B or 2C40 tube which changes the plate-to-grid region of the resonant cavity. The power output is adjusted by changing the plate voltage with the R.F. OSC. OUTPUT potentiometer, R25, shown in figure 33. When a tube is replaced, the length of the grid cylinder assembly (D) must be adjusted to compensate for the variations in interelectrode capacities between tubes in order that the proper frequency range may be covered. Each time the grid cylinder assembly is readjusted, the plunger (E) must be adjusted for maximum power output.

d. The polyiron chokes (K) are installed to prevent leakage of r-f power from the cavity along the d-c leads.

35. ELECTRICAL DESCRIPTION OF COMPONENTS.

a. Blocking Oscillator and Cathode Follower.

(*1*) The blocking oscillator provides a triggering signal of the desired repetition rate when the selector switch is in the CALIB or INT TRIG position. The basic blocking oscillator circuit is shown in figure 22. When B+ voltage is applied, the tube (V1A) begins to conduct because the grid is initially at zero voltage. The flow of electrons through winding B of transformer T2 sets up a voltage across winding A, causing a flow of electrons from

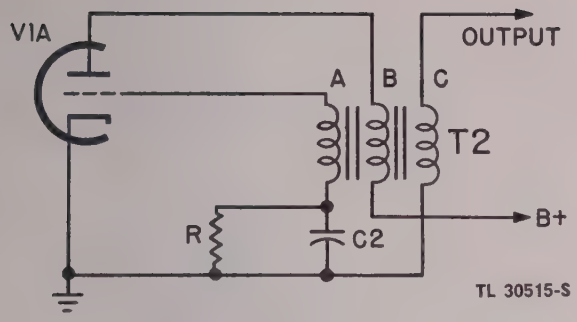


Figure 22. Basic blocking oscillator circuit.

one plate of capacitor C2 through resistor R. This makes the grid side of capacitor C2 positive, increasing the plate current as shown in figure 23. As saturation is approached, the induced voltage across winding A decreases. This causes the grid voltage to become less positive, causing less plate current to flow. The decrease in plate current through winding B induces a voltage in the opposite direction in winding A, causing electrons to flow to the grid side of capacitor C2. This makes the grid negative beyond cut-off. The resultant voltage across the output winding C is a single cycle of oscillation as shown in figure 23. This cycle is repeated when capacitor C2 discharges to the point where the grid voltage passes the cut-off point and the tube again begins to conduct. This time of discharge and, therefore, the repetition rate may be controlled by adjusting the values of the resistor and capacitor (fig. 24).

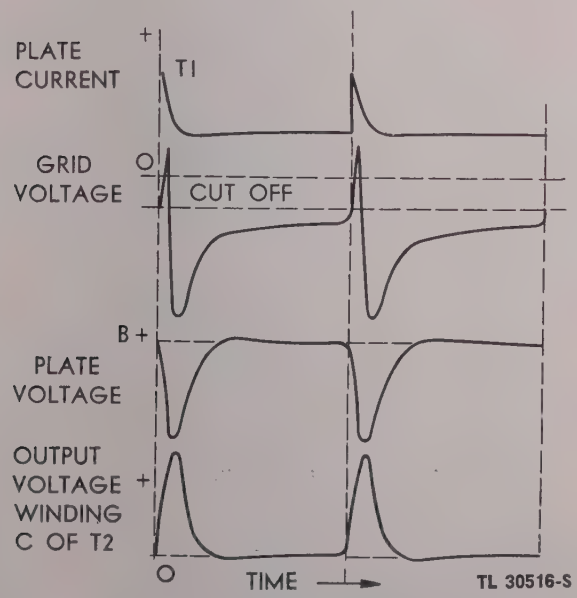


Figure 23. Blocking oscillator waveforms.

(*2*) When the selector switch is in the CALIB position, R (fig. 22) is composed of resistors R2 and R4. These values have been chosen for a repetition rate of approximately 650 cps. When the selector switch is in the INT TRIG position, R consists of resistor R2 and potentiometer R5. Variations of the potentiometer adjust for repetition rates between 120 and 2,000 cps. When the selector switch is in the EXT TRIG position, the grid is biased beyond cut-off so that the blocking oscillator is inoperative.

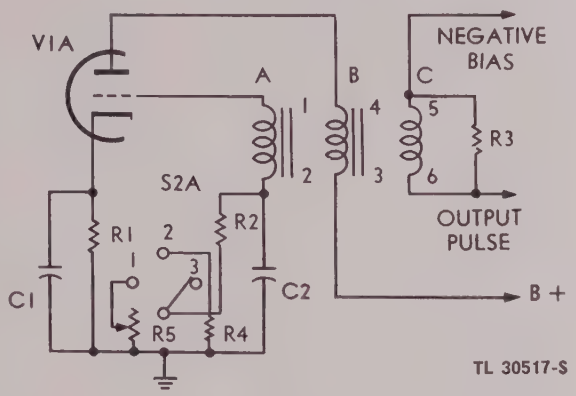


Figure 24. Blocking oscillator circuit.

(*3*) With the selector switch in the INT TRIG position, V1B is used to supply a positive pulse for triggering external equipment to the TRIGGER jacks (fig. 25). It also supplies a negative pulse for triggering the delay multivibrator through the trigger inverter section. With the selector switch in the CALIB position, a positive pulse is applied to the pulse multivibrator through the buffer tube section (V2B).

(*a*) The phase splitter circuit (fig. 25) produces two output voltages which are 180° out of phase. One output is taken from the plate and one from the cathode of tube V1B. This circuit is essentially an impedance-matching device with less than unity voltage gain but possessing power gain. Its high input impedance and very low output impedance render it particularly suitable for coupling a pulse generating stage to a transmission line. The pulses from the blocking oscillator transformer are applied to the negatively biased grid of V1B. Cathode resistor R6 is unbypassed and, when the grid voltage increases (i.e., becomes positive or less negative), the corresponding increase in cathode current develops a voltage across resistor R6 which is in phase with the voltage applied to the grid but smaller in magni-

tude. The voltage across resistor R6 produces degeneration (inverse feedback) by decreasing the voltage from grid to cathode. The voltage across resistor R6 is coupled through capacitor C10 (fig. 33) to the TRIGGER jacks when the selector switch is in the INT TRIG position, and thus is available for triggering external equipment. This voltage is also coupled through capacitor C9 to the grid of V2A where it is used to trigger the pulse circuits.

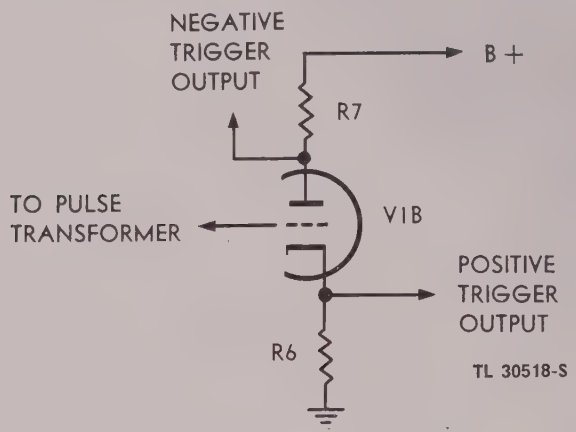


Figure 25. Phase splitter circuit.

(*b*) When the grid voltage of V1B increases, the increased plate current through resistor R7 increases the voltage drop across that resistor, lowering the plate voltage so that the positive pulse on the grid is transformed to a negative pulse at the plate. The negative pulse is coupled through capacitor C8 (fig. 33) to the cathode of V2A when the switch is in the INT TRIG position, where it acts with the pulse coupled to the grid to trigger the pulse circuits.

(*c*) With the selector switch in CALIB position, the positive pulse from the cathode resistor R6 is coupled through C9 to the buffer tube section, V2B.

b. Trigger Inverter. With the selector switch in the EXT TRIG position, the delay multivibrator is triggered with a signal of the correct polarity, whether the input trigger is positive or negative, by means of the trigger inverter (fig. 33).

(*1*) *Negative Trigger.* When the input trigger polarity switch (S3) is in the − (minus) position, the negative trigger is coupled to the cathode (pin 6) of V2A. The trigger drives the cathode negative, which is equivalent to driving the grid more positive. The trigger signal appears at the plate of V2A as a negative pulse.

(*2*) *Positive Trigger.* When the input trigger polarity switch (S3) is in the + (plus) position, the positive trigger is coupled to the grid (pin 4) of the delay multivibrator input tube V2A. The trigger signal appears at the plate of V2A as a negative pulse.

c. Delay Multivibrator (fig. 26).

(*1*) During the intervals between triggers, V3B conducts because its grid is at zero potential with respect to its cathode. The plate current of V3B passing through R23 biases V3A beyond cut-off. This situation is maintained until a trigger is applied, as shown in figure 27–2.

(*2*) When a trigger is applied to trigger inverter tube V2A, the plate current increases and the plate potential drops. The plates of V2A and V3A are tied together. Because of this, a drop in the potential at the plate of V3A is produced when the increased plate current of V2A passes through R19 (fig. 27–3).

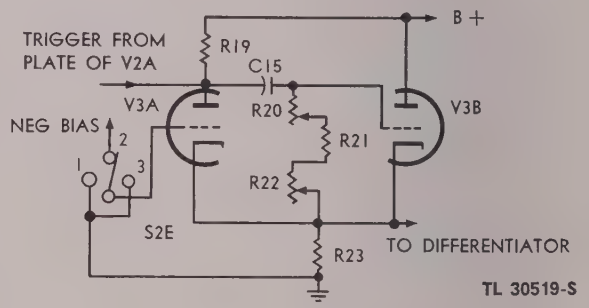


Figure 26. Delay multivibrator circuit.

(*3*) Since the potential differences across capacitor C15 cannot change instantaneously, the potential of the grid of V3B drops together with that of the plate of V3A (fig. 27–4). This drop decreases the plate current through V3B and decreases the negative bias on V3A sufficiently to allow V3A to conduct. The plate current through V3A produces a drop across R19, reinforcing the original drop in voltage at the plate of V3A. This new drop in voltage at the plate of V3A is again transmitted through capacitor C15 to the grid of V3B. The process continues until V3B is completely cut off, while V3A is conducting.

(*4*) Thus the arrival of the trigger does two things simultaneously: stops the current through V3B and starts the current through V3A. The current through V3A is much less than the current

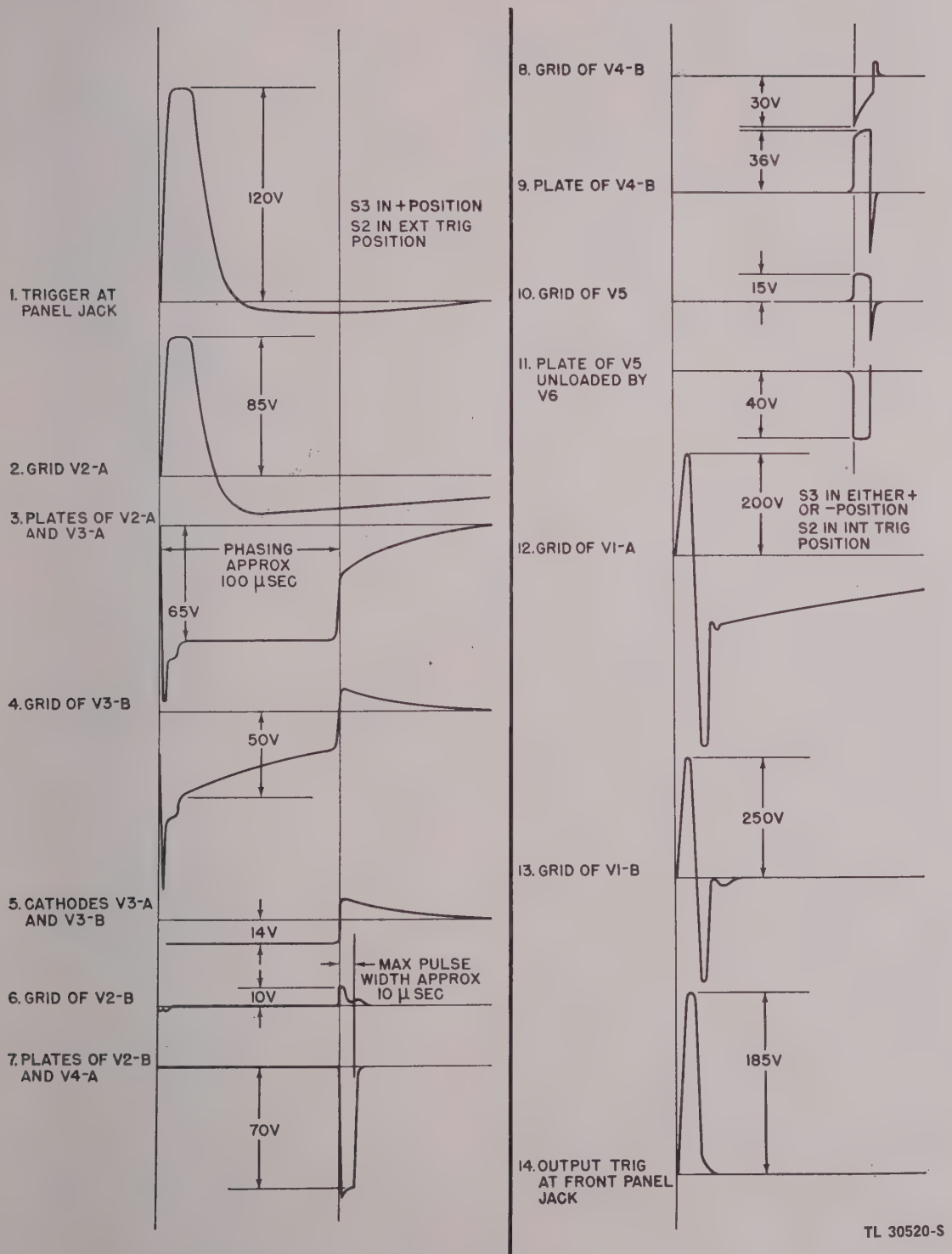


Figure 27. Waveforms.

through V3B (when conducting) because of the presence of R19 in the plate circuit of V3A. The potential drop across R23 decreases, therefore, since the plate currents of both V3A and V3B pass through that resistor.

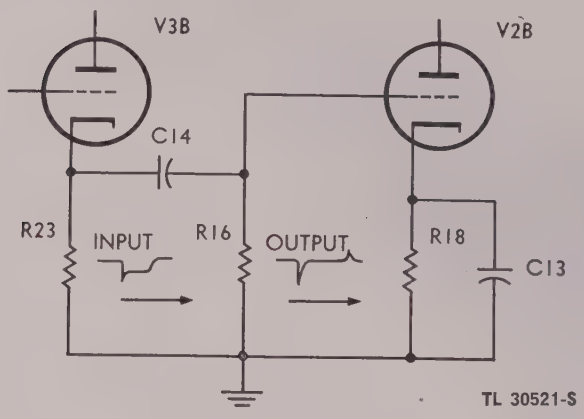


Figure 28. Differentiator circuit.

(*5*) The grid of V3B remains below cut-off while capacitor C15 discharges through the series-resistance combination of R20, R21, and R22 (fig. 26). The time of discharge depends upon the time constant of the capacitance-resistance combination (R-C) (C15 and R20, R21, R22, figs. 26 and 33). As soon as the grid of V3B reaches the cut-off point, V3B begins to conduct. The current through V3B, passing through R23, increases the negative bias on the grid of V3A, thereby decreasing the current through V3A. The decrease in V3A current through R19 causes the voltage at the plate of V3A to rise. This rise is transmitted through capacitor C15 to the grid of V3B, whose potential is raised still further above cut-off. This cycle of events is repeated until V3A is cut off completely, while V3B is once again conducting. Thus the conditions preceding the arrival of the pulse are re-established and maintained until the arrival of the next pulse.

(*6*) The output (fig. 27–5) of the multivibrator is the voltage across R23. As explained above, the voltage across R23 drops suddenly upon the arrival of a trigger and then just as suddenly rises when C15 discharges sufficiently to permit V3B to conduct. The minimum pulse width obtainable is determined by R21 and the resistance of R20 and R22.

d. Differentiator.

(*1*) The differentiating circuit (fig. 28) converts the rectangular pulses from tube V3B into negative and positive pulses by the R-C differentiator consisting of C14 and R16. The R-C time constant (1.5 μsec) is small compared to the length of the input pulse, and therefore capacitor C14 discharges quickly after each change in cathode voltage of tube V3B.

(*2*) Since V2B, the buffer tube has a large self bias, the negative trigger resulting from the leading edge of the pulse from V3B has little affect on it. The positive pulse from the R-C circuit (C14 and R16) resulting from the trailing edge of the pulse from V3B causes tube V2B to conduct, thus triggering the pulse width multivibrator V4B at a time delay after the input trigger which is equal to the width of the delay multivibrator pulse previously described.

(*3*) Thus the rectangular pulse produced by the delay multivibrator is converted into a short negative pulse followed by a short positive pulse, separated by the width of the rectangular pulse. The width of this rectangular pulse is controlled by the pulse delay controls (fig. 26) R20 (coarse) and R22 (fine). The negative pulse corresponds to the time of the trigger obtained from the transmitter. The positive pulse triggers pulse multivibrator tube V4 through buffer tube V2B.

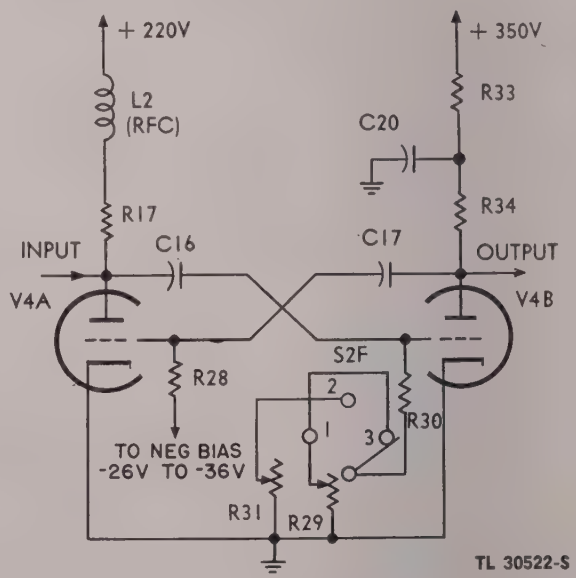


Figure 29. Pulse multivibrator circuit.

e. Pulse Multivibrator (fig. 29). The positive pulse from the differentiating circuit in triggering the pulse multivibrator tube V4 (through buffer tube V2B) produces a rectangular wave output whose width is variable by means of pulse width control R29; control R31 adjusts the calibrated pulse width. This rectangular pulse is passed onto the driver tube, V5.

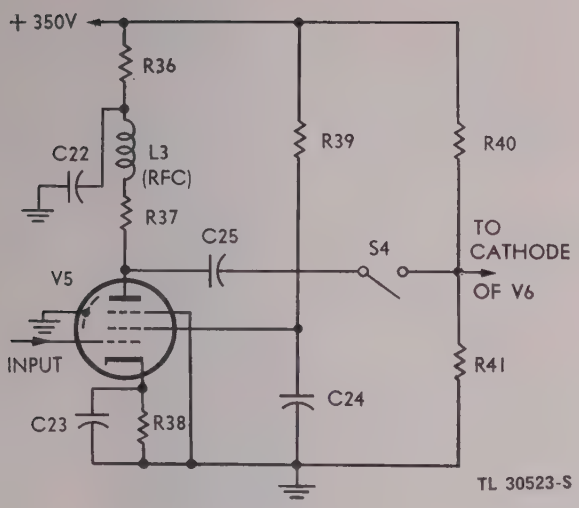


Figure 30. Pulse modulator circuit.

(*1*) In the absence of a triggering signal, V4B is conducting. During this time V4A is nonconducting, being biased beyond cut-off by the negative voltage from the fixed bias supply. A positive trigger (fig. 27–6) from the output of the differentiator applied to buffer tube V2B of the pulse multivibrator causes a sudden drop in the voltage at the plate of V4A. This drop is transmitted through capacitor C16 to the grid of V4B (fig. 27–7). This causes the current through V4B to decrease and the plate voltage of V4B to rise. The latter rise is transmitted through capacitor C17 to the grid of V4A, carrying this grid past cut-off. This starts and increases the current through V4A and further decreases the voltage at the plate of V4A. This process continues until V4B is cut off. V4B remains cut off until C16 discharges through R30 and R31 or R29 (depending on the position of the selector switch) sufficiently for the potential of the grid to rise to cut-off. V4B then starts to conduct, and the reverse of the process just described takes place until V4A is cut off and V4B is conducting. The length of the output pulse (fig. 27–9), which is taken from the plate of V4B, depends on the time constant of the R-C combination C16, R30, and either R31 or R29 (fig. 29).

(*2*) The R-C combination R33-C20 acts as a decoupler. The r-f choke L2 helps to square the output pulse.

(*3*) The minimum pulse width obtainable will be determined by the value of R30 (fig. 29).

f. Modulator. The rectangular pulse developed in the pulse multivibrator is amplified and shaped by tube V5. The shaping consists of improving the "squareness" of the pulse. This stage consists of pentode amplifier tube V5 shown in figure 30. The internal shield and the suppressor grid are tied to ground. Screen voltage is supplied through a dropping resistor R39 which is bypassed by C24. C22 is the plate bypass capacitor. The output of V5 (plate, pin 8) is a negative rectangular pulse (fig. 27–11) which is coupled to both cathode and plate of oscillator tube V6 through capacitor C25, when the R.F. OSC. switch (S4) is in the ON position.

g. Cavity Oscillator Tube. The cathode of V6 (cavity oscillator tube) is positively biased by voltage divider R40 and R41 (fig. 30). This is equivalent to a negative bias beyond cut-off on the grid and keeps tube V6 from oscillating when it is not keyed by the output pulse of V5. The negative pulse from the output of V5 (plate, pin 8) on the cathode of V6 momentarily raises the grid above cut-off and permits the tube to oscillate. This produces a train of r-f oscillation, with a rectangular envelope, whose duration is equal to the width of the modulating pulse.

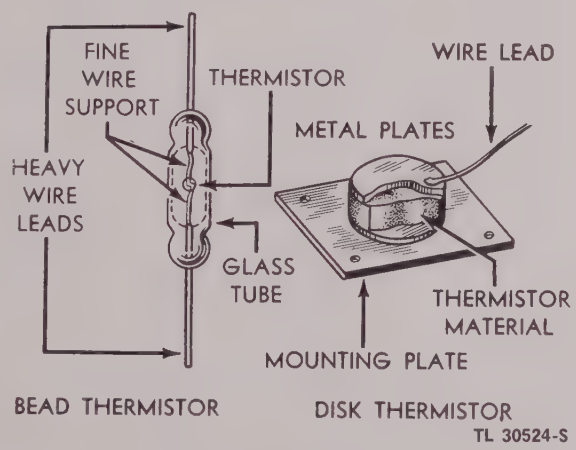


Figure 31. Thermistors.

h. Thermistor Bridge. The thermistor bridge measures power by use of a variable resistance element, a thermistor, in a bridge circuit. The thermistor resistance decreases with increasing temperature and vice versa. Changes of thermistor temperature and hence of resistance may be caused by thermal changes in its environment, by alternating or direct currents flowing through it, or by absorbed r-f power.

(*1*) *Basic Thermistor Bridge Circuit.*

(*a*) There are two classes of thermistors used in the signal generator (fig. 31). The *bead* thermistor

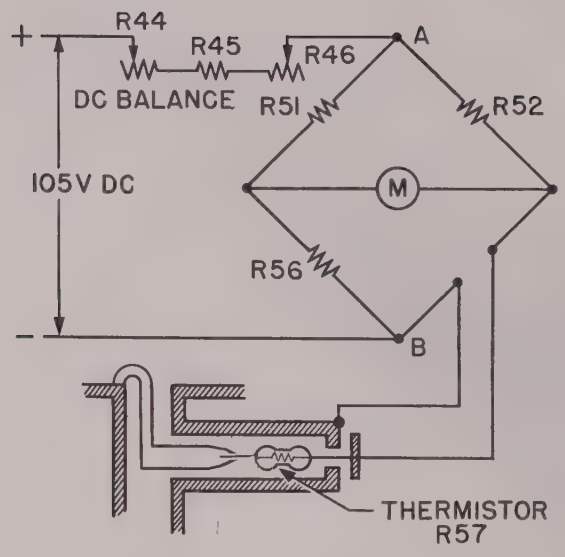


Figure 32. Thermistor bridge circuit.

used for power measurement has a small mass and is affected by the changes mentioned above. The *disk* thermistor used in compensating networks has a large mass, and its resistance is relatively insensitive to the current flowing through it. It is mounted on the outside of the cavity, and its resistance is dependent primarily on the ambient temperature. A simplified thermistor bridge circuit is shown in figure 32-A. The Wheatstone bridge consists of resistors R51, R52, R56, and bead thermistor R57 (fig. 32). No current flows in meter M when the Wheatstone bridge is balanced. The bridge is balanced when the resistances meet the following conditions:

$$\frac{R56}{R57} = \frac{R51}{R52}$$

The bridge is balanced with no r-f power heating the thermistor bead (R57) by adjusting the METER ZERO SET control, R46, which varies the current in bead thermistor R57, changing the thermistor temperature. Since the thermistor resistance changes with temperature, the resistance of bead thermistor R57 can be adjusted by METER ZERO SET control R46 to meet the balance condition of the above equation.

(*b*) After meter M has been set to zero reading, r-f power can be measured by feeding the power into the R.F. jack on the front panel. The r-f power absorbed by the thermistor increases its temperture, decreasing its resistance and unbalancing the bridge so that current flows through meter M. The current flowing through the meter is proportional to the r-f power absorbed.

(*c*) This basic thermistor bridge circuit has two disadvantages: The sensitivity (microamperes of meter reading per milliwatt of r-f power) varies with temperature, and the METER ZERO SET control has to be adjusted for every measurement because of changes in thermistor bead temperature. The methods of compensating for this effect in the signal generator are described in the following paragraphs.

(*2*) *Compensation for Change in Sensitivity.*

(*a*) The thermistor bridge shown in figure 32-A increases in sensitivity with decrease in temperature. The sensitivity (ohms/watt) of the thermistor remains constant over a broad temperature range, but the bridge sensitivity (microamperes meter reading per milliwatt of r-f power) increases with decrease in temperature. As the

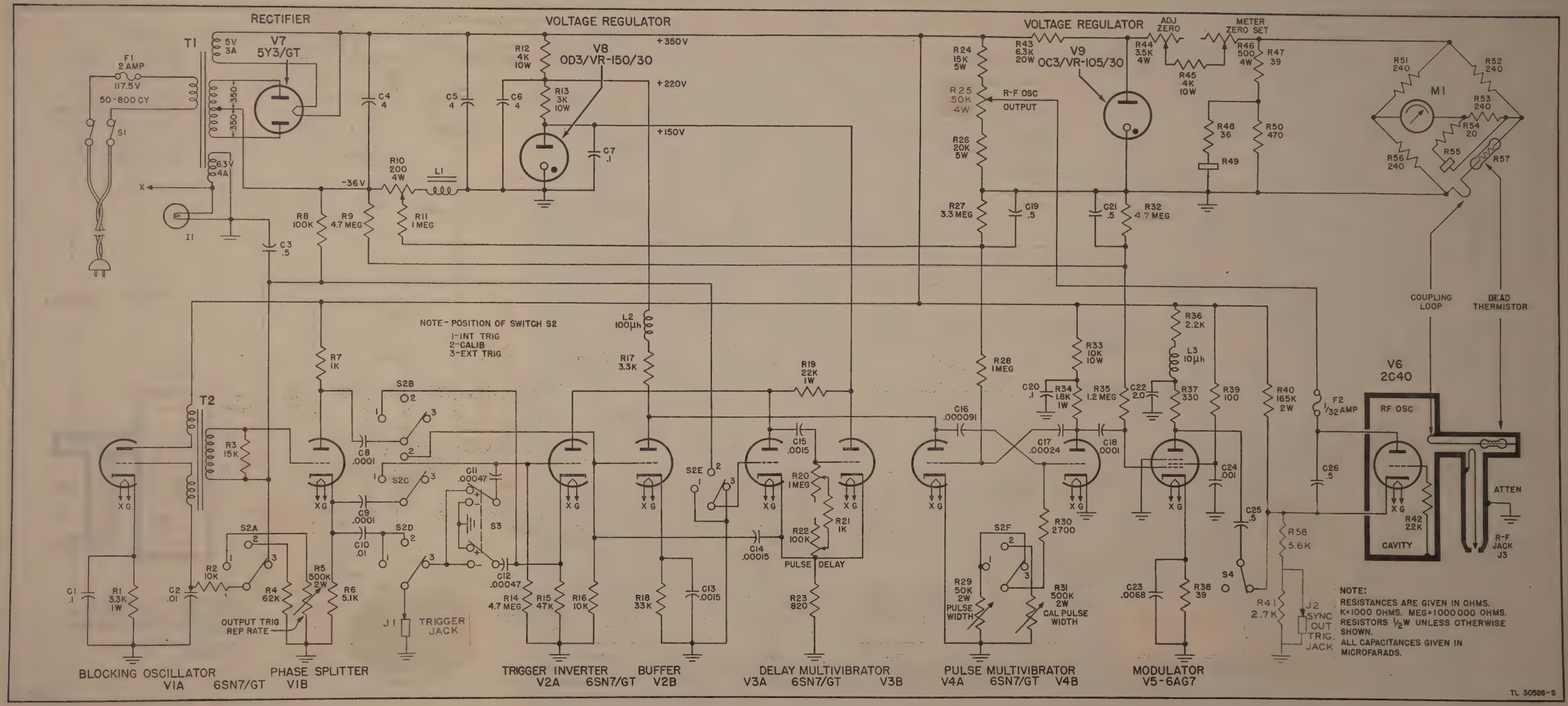


Figure 33. Signal Generator 215-C complete schematic diagram.

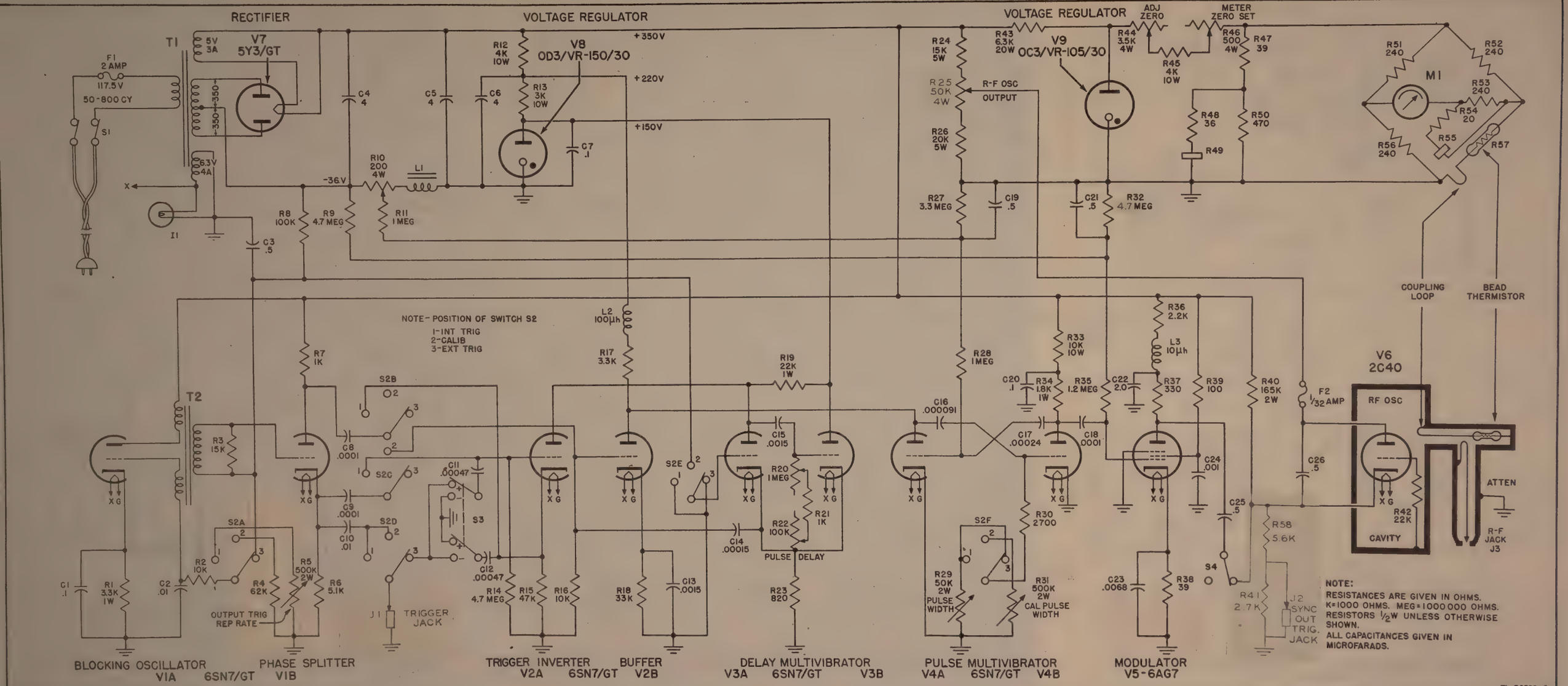


Figure 33. Signal Generator 215-C complete schematic diagram.

temperature decreases, the thermistor resistance, R57, tends to increase, making it necessary to adjust METER ZERO SET control R46 to apply a higher voltage across points A and B. Thus the current through meter M is greater at a lower temperature because of both a given change in thermistor resistance and the higher voltage across A and B.

(*b*) This variation in sensitivity is compensated for by increasing the meter resistance as temperature decreases. This is accomplished by the use of a thermistor which has the property of increased resistance with decreased temperature. A disk thermistor (R55) is mounted outside the cavity in series with the meter (fig. 32-B). It is necessary to put resistor R54 in series and resistor R53 in parallel, with appropriate values, to obtain the correct rate of change of resistance with temperature, so that the sensitivity of the bridge remains constant over the required temperature range.

(*3*) *Compensation for Zero Drift.* To decrease the number of METER ZERO SET adjustments, an automatic method of increasing the current through the bead thermistor, R57, with decrease in temperature is required. A disk thermistor whose resistance increases with decreasing temperature is mounted outside the cavity and connected in parallel with the bridge. More current flows through the bridge at lower temperature, because the ratio of the resistance of the shunting disk thermistor to the resistance of the bridge (across points A and B) is greater at lower temperature (fig. 32-C). Adjusting this compensation to cover the required temperature range, the disk thermistor, R49, is combined in a network with resistors R50, R48, and R47.

(*4*) *Complete Thermistor Bridge Circuit.* The compensating networks in the signal generator are designed for an average bead thermistor so that compensation is correct at 0°C and 60°C. Between these points, compensation is quite satisfactory. Because of the variation of electrical characteristics of bead thermistors, however, the METER ZERO SET control and ADJ ZERO control, cannot be entirely eliminated. Potentiometer R44 is added in series with R46 for factory adjustment of voltage applied to the thermistor bridge.

i. Attenuator. The power from the type 446B or 2C40 tube is coupled through a coupling loop (J) and coaxial line to the junction of the thermistor mount and attenuator (fig. 21). Part of the energy goes into the coaxial line to the thermistor bead (Y), and part is coupled by coupling loop (T) into a waveguide which is so small that large attenuation of the input signal results. The amount of attenuation is proportional to the length of the waveguide and is adjustable by the R.F. ATTENUATOR control. The transition back to coaxial line is made by the coupling loop (Q) backed by a resistive disk (R) which consists of a carbon-coated bakelite disk for terminating the coaxial line (X) with its characteristic impedance. An r-f bypass capacitor (V) and polyiron choke (U) are mounted in the thermistor housing (fig. 21) for r-f filtering purposes. The d-c path from the thermistor to ground is completed through the coupling loop (T).

j. Power Supply (fig. 33).

(*1*) The power supply uses a transformer T1, one 5Y3GT full-wave rectifier tube (V7), one VR150–30 voltage regulator tube (V8), and one VR105–30 voltage regulator tube (V9). Inductor L1 and capacitors C4 and C5 form an inductance-capacitance (L-C) filter with capacitor input.

(*2*) The voltage for the r-f oscillator tube (V6) is taken from the R.F. OSC. OUTPUT potentiometer (R25) in the voltage divider consisting of R26, R25, and R24 across the positive filter terminal and ground.

(*3*) The peak voltage for the delay multivibrator is regulated by a VR150–30 glow discharge voltage regulator (V8). The current of this voltage regulator tube is limited by resistors R12 and R13. Additional filtering is provided by C6 and C7.

(*4*) The voltage for the wattmeter bridge circuit is regulated by a VR105–30 glow discharge voltage regulator (V9). Resistor R43 is the current limiting resistor for this regulator tube.

(*5*) Negative bias voltage is obtained from the resistor drop in filter choke L1 and potentiometer R10.

36. FUNCTIONING OF SIGNAL GENERATOR CIRCUITS (fig. 33).

The individual circuits described above may be selected in various combinations by means of the selector switch. The performance of these circuits as combined in the different positions of the selector switch is described below.

a. Calibration (Calib).

(*1*) With the selector switch in the CALIB position (position 2, fig. 33), the power output of the signal generator is standardized. Under these conditions, the blocking oscillator puts out sharp

negative pulses at a repetition rate of approximately 650 cps. This frequency is determined by the time constant of R2, R4, and C2. The pulses are then inverted in tube V1B (fig. 33).

(*2*) The pulse from V1B is fed to the grid of tube V2B, where it is amplified, and triggers the pulse multivibrator. When triggered, the pulse multivibrator produces a relatively long rectangular pulse, whose length (20 to 40 μsec) is preset at the factory by adjustment of potentiometer R31. The rectangular pulse is passed on to the pulse modulator tube V5.

(*3*) Oscillator tube (V6) is pulsed into oscillation by the rectangular pulse applied to the oscillator cathode from pulse modulator tube V5. The width of these pulses is greater than that obtainable with the selector switch in either the INT TRIG or EXT TRIG position, so that the average power is sufficient to obtain full-scale reading of the power monitor meter for standardizing the peak power output. The power output of the oscillator is controlled by the R.F. OSC. OUTPUT control (R25) which varies the plate voltage of oscillator tube V6.

(*4*) The standardization in the CALIB position is made by setting the R.F. OSC. OUTPUT control so that the power monitor meter reads 200 (full-scale). The instrument will then furnish the proper peak power at the R.F. jack, when operated on INT TRIG or EXT TRIG, so that the R.F. ATTENTUATOR dial will be directly calibrated in −dbm.

b. Internal Synchronization (Int Trig). When the selector switch is on INT TRIG (position 1, fig. 33), the blocking oscillator tube (V1A) puts out a negative trigger at a repetition rate which can be varied between 120 and 2,000 cps by means of the OUTPUT TRIG FREQUENCY control, R5 (fig. 33). The pulses are inverted in tube V1B. This produces a negative pulse at the plate (pin 5) and a positive pulse at the cathode (pin 6) of phase splitter V1B. The negative pulse and positive pulse are then applied simultaneously to the cathode (pin 6) and grid (pin 4), respectively, of tube V2A, which in turn triggers delay multivibrator tube V3. This trigger sets off the entire process described in the analysis of the circuit and results in an r-f pulse of variable width and variable delay with respect to the trigger. The positive trigger from the cathode (pin 6) of V1B is also available at the TRIGGER jacks.

c. External Synchronization (Ext Trig). When the selector switch is on EXT TRIG (position 3, fig. 33), the signal generator may be triggered with either a positive or a negative trigger. The INPUT TRIGGER switch must be in the proper position: + or − for a positive or negative trigger, respectively. The external trigger is coupled in through one of the TRIGGER jacks. Since the two TRIGGER jacks are connected in parallel, an external trigger coupled into one of the jacks is available at the other jack for simultaneously triggering other equipment. The trigger is fed into the trigger inverter which applies a pulse of the correct polarity to the delay multivibrator, V3, setting off the entire process described in the analysis of the circuit, resulting in an r-f pulse of variable width and variable delay with respect to the trigger.

37. FUNCTIONING OF SIGNAL GENERATOR IN TESTING RADAR SYSTEMS.

The signal generator is used to measure the ability of a transmitter to radiate powerful r-f pulses and the ability of a receiver to detect weak returning pulses. The results of these measurements are expressed numerically for transmitter, receiver, or over-all radar performance. The procedure for measuring performance of radar sets with Signal Generator TS-155B/UP is described in part two, paragraph 15. The fundamentals of the method of testing radar sets with Signal Generator TS-155B/UP are illustrated in figures 34 and 35. The radar set and the signal generator are synchronized with the trigger from either one or the other as described in part two, paragraph 14. The signal generator is standardized as described in paragraph 36a.

a. Measuring Transmitter Power Output.

(*1*) Pulses of energy from the radar transmitter are radiated by the radar antenna through space, as shown in figure 34. When a horn antenna is used, part of the energy is picked up by the horn antenna and transmitted through the cable and signal generator attenuator to the power monitor of the signal generator. When a directional coupler is installed in the radar r-f line at point L of figure 34, a cable can be connected from the directional coupler to the R.F. jack of the signal generator. In this case a definite fraction of the radar transmitter energy is coupled through the directional coupler, cable, and r-f attenuator to the power monitor of the signal generator. When the signal generator controls are adjusted as outlined in part two, paragraphs 11 through 15, the power monitor meter reads the average power at the R.F. jack directly in milliwatts.

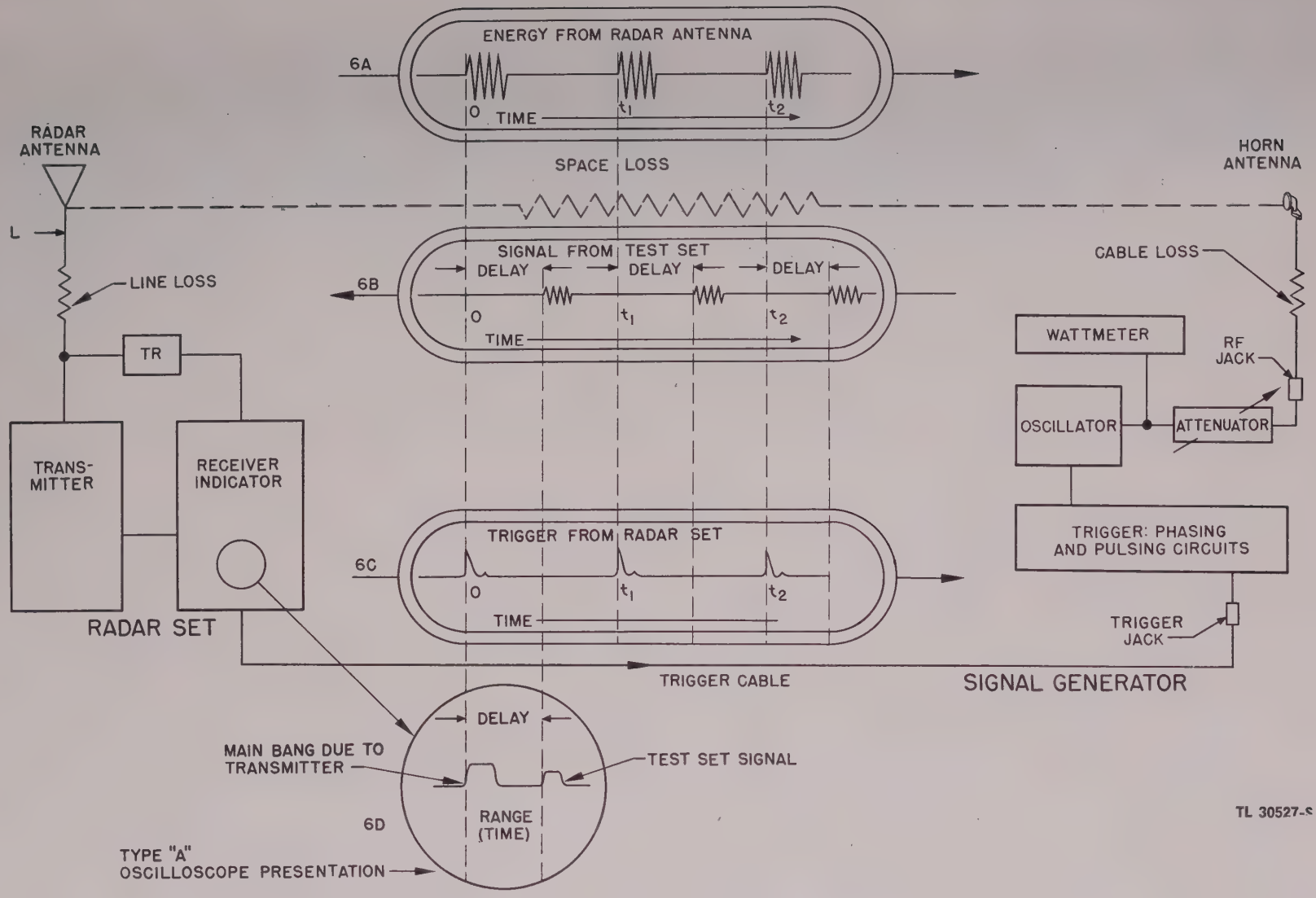


Figure 34. Signal Generator TS-155B/UP, operation with radar set.

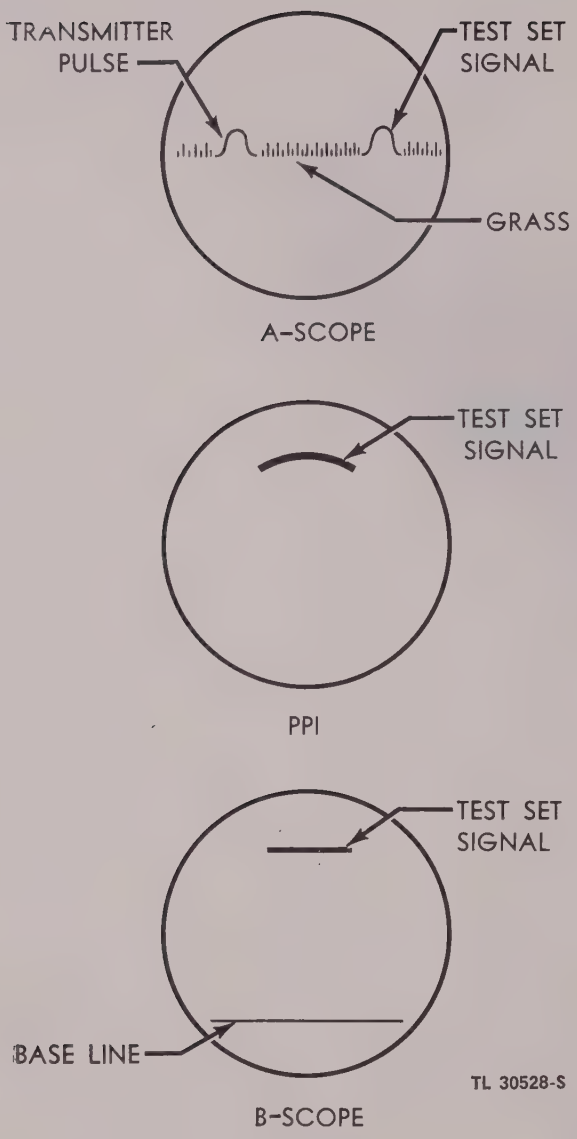


Figure 35. Test set signal on A-, PPI, and B-scopes.

(*2*) Note that, if a directional coupler is installed in the radar transmission line and the signal generator is coupled to it by means of an r-f cable, it is necessary only to know the cable loss and the attenuation constant of the directional coupler to determine the average power at the radar transmitter (fig. 34). Since the attenuation constant of a directional coupler, located in the r-f line of a radar set, always remains constant, the test procedure using a directional coupler is preferred to that of using a horn antenna to couple the signal generator to the radar set. In the latter method, the radar antenna gain, space loss, and horn antenna gain must be known in order to convert to average power behind the radar antenna (point L in figure 34). For radar sets having no directional coupler, it is necessary to use this method of coupling. If periodic checks are made using the horn antenna to couple to the radar antenna, the horn antenna installation must be as nearly as possible the same each time; in any case, the distance between horn antenna and radar antenna must conform as nearly as possible to table I. Otherwise the coupling loss data as given in table II will not be correct. The coupling loss as given in this table is defined as the radar antenna gain, space loss, and horn antenna gain combined.

b. Measuring Receiver Sensitivity.

(*1*) The signal generator is used to generate a signal of the same frequency as the radar transmitter for testing the receiver sensitivity. After measuring transmitter power output, the cavity is adjusted to the transmitter frequency by tuning to a dip in the power monitor meter reading. The R.F. TUNING dial is then corrected by a constant amount (increase dial reading by three divisions) to compensate for the difference between the "cold" resonant frequency of the oscillator cavity and the resonant frequency of the cavity with the type 446B or 2C40 tube oscillating. The timing of the signal generator pulses is controlled by the trigger from the radar set. The delay time of the signal generator pulse, after the trigger from the radar set, is controlled by the delay circuits of the signal generator. Figure 35 shows the signal from the signal generator presented on various types of oscilloscopes.

(*2*) The signal observed on the radar indicator should be adjusted below saturation by means of the signal generator R.F. ATTENUATOR. The power output of the signal generator is standardized by first adjusting the oscillator for full-scale reading of the power monitor meter, with the selector switch in the CALIB position as described in part two, paragraph 15. The selector switch is then returned to INT TRIG or EXT TRIG, depending upon the synchronization used. The relative receiver sensitivity is measured by turning the R.F. ATTENUATOR dial until the test signal produced by the signal generator on the radar indicator is just visible in the noise. The R.F. ATTENUATOR dial reading give the peak power at the R.F. jack (in −dbm) of the smallest signal observable with the radar receiver.

SECTION X. MAINTENANCE

38. PRINCIPAL PARTS OF TEST SET.

The principal parts of the instrument that may require servicing are:

a. Cavity.

b. Thermistor bridge monitoring system.

c. Attenuator.

d. Pulsing and internal trigger circuits.

e. Power supply.

39. ACCESS TO PARTS FOR MAINTENANCE.

a. The chassis and front panel may be removed from the cabinet by loosening the seven captive screws (Nos. 1 through 7) on the front panel (fig. 5).

b. When the chassis has been removed, access is gained to all items such as tubes, pilot lamp, fuses, etc., which require easy replacement, with the exception of type 446B or 2C40 tube, which is located within the cavity, and the bead thermistor which is located within the thermistor housing. All circuit components such as resistors and capacitors may be easily reached and replaced if necessary. Most of these are mounted on terminal strips located in the bottom of the chassis (fig. 12).

40. PULSING AND INTERNAL TRIGGER CIRCUITS.

a. General. The theoretical discussion of these circuits given in section IX should be read before investigating the performance of these circuits. Figures 11, 12, and 33 are helpful in locating parts and tracing trouble. Paragraph 43 contains voltage and resistance charts. The waveforms normally found throughout the system are shown in figure 27. In general, if the correct waveform is seen at the *input* of any stage but an improper one at the *output* of the same stage, a replacement tube should be tried and the plate voltage checked before attempting further tests of the circuit.

b. Pulsing Circuit. The pulsing circuit should be checked for each of the three positions of the selector switch.

(*1*) *Calib Position.*

(*a*) The circuit may be checked by connecting the trigger input of a synchroscope to a TRIGGER jack on the signal generator. The synchroscope signal input should be connected between the cathode of type 446B tube and ground. Also, connect a jumper from the high side of C10 to the central terminal of the TRIGGER jacks. Essentially, a square pulse of fixed width and repetition rate should be observed. If a synchroscope is not available, a rough check may be made with an oscilloscope of high sweep speed by connecting it in the same manner. A recurrence frequency of approximately 650 cycles is required.

(*b*) The pulse amplitude should be about 30 volts, and the pulse should start (on the synchroscope screen) at the beginning of the sweep. If the pulse waveform is distorted or does not appear, the synchroscope should be used to observe the waveform at the grid of B5 (pin 4), at the plate of tube V4B (pin 5), and at the plate of V2B (pin 2).

(*c*) If no pulse is found at the plate of V2B (pin 2), a check should be made at the grid (pin 1) of this tube. At this grid a positive trigger from the cathode of V1B (pin 6) should be observed. If it is not, the blocking oscillator tube, V1A, is probably not functioning and should be checked.

(*2*) *Int Trig Position.*

(*a*) In this type of operation, a positive trigger should be available at either of the TRIGGER jacks. The repetition rate of this trigger can be varied by means of the OUTPUT TRIG FREQUENCY control.

(*b*) When a synchroscope is synchronized with this trigger, synchronization is indicated by varying brightness of the sweep trace as the OUTPUT TRIG FREQUENCY control is varied. (Note that some synchroscopes cannot be triggered if the repetition rate is too low, about 400 cycles.)

(*c*) With the R.F. OSC. switch ON, a short pulse (whose width is variable by means of the PULSE WIDTH control) should be observed on the cathode and on the plate of the r-f oscillator tube (V6). If the pulse is distorted but its delay can be varied by the PULSE DELAY control, look for trouble only as far back in the circuit as the first plate (pin 2) of V4A.

(*d*) If no pulse appears or if the delay cannot be controlled by the PULSE DELAY control, the waveforms at the plates (pins 2 and 5) and the cathode (either pin 3 or pin 6) of tube V3 should be checked and compared with the corresponding forms in figure 27.

(*e*) The trailing edges (right-hand side on synchroscope screen) of the pulses found on the cathodes (pins 3 or 6) should be movable by means of the PULSE DELAY control. If these waveforms do not appear, or if they are quite distorted, a tube check and a plate voltage check should be made on this stage.

(*3*) *Ext Trig Position.* The INPUT TRIGGER polarity switch is set to correspond to the polarity of the external trigger fed into one of the TRIGGER jacks. The operation of the circuit is very similar to that on the INT TRIG position except that switch S3 permits use of triggers of either polarity and that tube V1A does not oscillate.

NOTE: It is very important that all the spring fingers in the resonant cavity make good contact, because even a few spring fingers that do not make good contact can prevent the tube from oscillating. Most troubles with the r-f oscillator are caused by poor contacts or defective tubes. See paragraph 46 for information on how to disassemble cavity.

c. Power Supply. The power supply is a conventional full-wave rectifier system with various voltage outputs filtered by individual R-C filters. Lack of or incorrect d-c voltage at any point in the signal generator can often be traced to the power supply, the repair of which usually consists of replacing defective tubes or burned-out resistors or capacitors.

41. THERMISTOR BRIDGE MONITORING SYSTEM.

a. Set the selector switch to CALIB and turn on the signal generator. It should be possible to zero-set the monitoring meter by means of the METER ZERO SET control. If this is not possible, the voltage across the thermistor bridge, between ground and the junction of R51 and R56, should be checked. This voltage should read between 1.4 volts and 1.5 volts. The variable resistor (R44) should be adjusted until it is possible to zero-set the monitoring meter with METER ZERO SET control on the front panel.

b. If it is still impossible to zero-set the monitoring meter, measure the voltage at the anode of tube V9. This voltage should be close to 105 volts. Make a continuity check of the thermistor bridge circuit, particularly of the bead thermistor.

c. The resistance of the bead thermistor varies with the amount of current flowing through the bead, and hence, this indication is affected by the type of ohmmeter that is used. With the average ohmmeter, the resistance should measure between 500 and 1,500 ohms. A more exact specification is that the resistance at 23.9°C, with 25 milliamperes (ma) of direct current flowing through the bead, should lie between 33 and 47 ohms. In general, it may be said that if the bead has continuity, it will operate in the monitoring bridge circuit.

d. The resistance of the bead thermistor can be measured by disconnecting the lead at the end of the thermistor housing and placing the ohmmeter leads between the frame of the chassis and the threaded screw at the top of the upper section of the thermistor housing. For information on how to replace the thermistors, see paragraph 44b.

42. ATTENUATOR CABLE.

If the monitoring meter indicates that the cavity is oscillating and is developing sufficient power but the power at the R. F. jack is inadequate, the trouble probably lies between the thermistor connecting link and the connector for the attenuator cable. Make a check of the attenuator cable. This cable receives considerable flexing while the instrument is in use. It is therefore reasonable to expect that this part may fail. To check this, disconnect the attenuator cable and measure the power at the output of the attenuator piston. If the power is of the correct magnitude at this point, replace the attenuator cable with a new one.

43. TEST ANALYSIS DATA.

a. General. The following data was obtained with a standard 20,000-ohms-per-volt analyzer. Although the measurements indicate the values to be expected, each signal generator differs to some extent. Therefore, it is recommended that similar charts be prepared by the using unit for each signal generator that is operating properly.

b. Voltage Chart. The following voltages were measured between the tube socket pin indicated and ground, using a 20,000-ohms-per-volt meter. No external trigger voltage was used. The R. F. OSC. switch was off.

c. Resistance Chart. The following resistances were measured from the tube socket pins indicated to ground. A 20,000-ohms-per-volt meter was used. No power was supplied to the signal generator. The R. F. OSC. switch was off.

TABLE IV

VOLTAGE CHART

Switch position	*Tube*	*PIN* 1*	2	3	4*	5	6	7	8
EXT CALIB INT	V1	−42	330	0 0.7 0.1 to 2.5†	−42	330	0 7.6 1 to 28†	6.3 ac	0
EXT CALIB INT	V2	0	220	14	0 0 −5 to −70†	145 145 125 to 145†	8.2 7.5 0.5 to 6.3	6.3 ac	0
EXT CALIB INT	V3	12 to 15** 12 to 15** 16 to −20‡	150	14 to 15** 13 to 15** 4 to 15‡	0 42 0	145 145 90 to 145‡	14 to 15** 13 to 15** 4 to 15‡	6.3 ac	0
EXT CALIB INT	V4	−0.1 to −0.3§ −1.0 −0.4 to −0.8§	135	0	−30	225 220 220 to 225†	0	6.3 ac	0
	V5	0	0	0	−25	0.3 to 0.4	330	6.3 ac	320
EXT CALIB INT	V6		0	16 20 16				6.3 ac	
	V7		350***		−45 310 ac		−45 310 ac		350***
	V8		0			147			
	V9		0			105			

* Taken with RCA Voltohmyst Jr.
† Varies with OUTPUT TRIG FREQUENCY control.
‡ Varies with PULSE DELAY and OUTPUT TRIG FREQUENCY control.
§ Varies with pulse width control.
** Varies with PULSE DELAY control.
*** 5 volts ac between pins 2 and 8.
All voltages are + dc unless otherwise stated.
Power line voltage set to 117.5 v, 60 cycles.

TABLE V

RESISTANCE CHART

	PIN								
Tube	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*Selector switch*
V1	100,000	11,000	5,100	110,000 72,000 10,000 to 510,000*	10,000	3,300	0	0	EXT CALIB INT
V2	10,000	17,300	33,000	4.7 meg	39,000	47,000	0	0	
V3	1,820 ohms to 1.1 meg †	17,000	820	0 100,000 0	39,000	820	0	0	EXT CALIB INT
V4	2,700 to 52,700** 2,700 to 503,000*** 2,700 to 52,700**	22,000	0	1.7 meg	17,300	0	0	0	EXT CALIB INT
V5	0	0	0	4.2 meg	39	10,000	0	12,500	
V6‡		0	8,200				0		
V7		10,000		500		500		10,000	
V8		0			17,000				
V9		0			4,500				

* Varies with OUTPUT TRIG FREQUENCY control.
† Varies with PULSE DELAY control.
‡ Resistance at plate of V6 varies with output control from 13,000 to 16,000.
** Varies with PULSE WIDTH control.
*** Depends on CAL PULSE WIDTH setting.

44. MECHANICAL REPAIRS.

a. Replacing a Type 446B or 2C40 Tube (figs. 19 and 20).

(*1*) Turn the POWER switch and R. F. OSC. switch off and disconnect the power cord from the main source.

(*2*) Remove the grid leak housing (48) from the cavity.

CAUTION: The grid leak housing which contains the grid leak must be removed before the tailpiece. It must not be replaced until the tailpiece has been permanently reassembled to the cavity; otherwise damage may result to the grid cylinder assembly and to the grid leak.

(*3*) Turn the tuning dial[8] to 100. This moves the plate cap fingers to a position close to the end of the plate cap of the tube and minimizes the possibility of breaking the tube when it is removed.

(*4*) Remove the tailpiece (53) from the cavity. Loosen, but do not remove, the clamping nut (52).

(*5*) Withdraw the tailpiece by rotating it slightly and pulling backwards.

(*6*) Remove the grid cylinder sleeve assembly (47) from the tube, being careful not to break the grid ring of the tube to which this assembly is attached.

(*7*) Insert a new tube in the socket of the tailpiece.

(*8*) Install the grid cylinder sleeve assembly on the grid ring of the tube, taking care to prevent breaking the tube. The length (47) of this assembly should not be changed at this time.

NOTE: Before installing the grid cylinder sleeve assembly and the type 446B or 2C40 tube, thoroughly clean them with Solvent, Dry-cleaning, Federal Specification P-S-661a. Be careful not to get finger marks on either.

(*9*) Insert the tailpiece fully in the cavity using a slight rotary motion and taking care that the plate cap is entering the plate cap fingers without undue strain. Because of the sliding action of the tube socket, eccentric tubes will be accommodated. The variation in heights of different tubes is accommodated by the telescoping action of the tailpiece within the cavity. After the tailpiece has been fully inserted so that the base of the plate cap of the tube is contacting the end of the plate cap fingers with the tuning dial set at 100, the tailpiece may be clamped in position by tightening the clamping nut (52). Make sure the clamping nut is tight enough to clamp the tailpiece. Turn the tuning dial throughout its range to make sure there is no binding and if necessary loosen the clamping nut (dial reading 100) and rotate the tailpiece slightly so that the tube may adjust itself; then tighten the clamp nut and recheck the tuning mechanism.

(*10*) Replace the grid leak. No further adjustment of the tuning mechanism is required.

b. Replacing the Thermistors (figs. 19 and 20).

(*1*) Two types of thermistors are used in the thermistor bridge monitoring circuit. These are the bead thermistor and the two disk thermistors.

CAUTION: The thermistors rarely need replacing and should be replaced only when proved defective. The bead thermistor, particularly its mounting, is quite delicate.

(*2*) The bead thermistor is a small glass unit about $\frac{3}{8}$ inch long and $\frac{1}{3}$ inch in diameter with short lengths of wire projecting from each end which act as terminals.

(*3*) The bead thermistor (21) may be removed from the thermistor housing by loosening the clamping nut on the thermistor housing and removing the assembly. The wire lead from the bead thermistor may now be seen projecting through the spring fingers of the brass disk. With a pair of long-nose pliers or tweezers, carefully lift this small projecting wire. This will extract the bead thermistor and brass disk.

(*4*) If a new bead thermistor is to be installed, one of the projecting leads should be cut to the same length as the lower lead of the replaced thermistor which had been inserted into the split fingers (26) of the thermistor line (24). The other lead on the new bead thermistor should not be cut at this time. Leaving this top lead with its original length will facilitate the insertion of the bead thermistor into the split fingers of the line. It will also provide an easy means of replacing the brass disk which was removed with the old bead thermistor. The end of the bead thermistor from which the wire was cut should be lowered into the thermistor housing and pushed into the split fingers (26) of the line (24). After the brass disk is pushed down over the projecting lead from the bead thermistor and seated on the base of the opening at the top of the thermistor housing, the wire lead may be cut about $\frac{1}{16}$ inch above the top of the brass disk.

(*5*) Replace the elements of the thermistor housing and tighten the clamping nut.

(*6*) The disk thermistors may be removed by removing their securing screws (four to each unit). Note that one of the disk thermistors is grounded and that the other is insulated from ground by a thin mica sheet.

c. Attenuator (figs. 19 and 20). This unit rarely requires servicing although it is possible that the contact fingers of the piston may require adjustment or cleaning. This would be indicated by an intermittent contact as the attenuator is adjusted. Instructions for removing the piston are given in paragraph 46.

45. ADJUSTMENTS (figs. 19 and 20).

a. Adjustment of Electrical Constants of Cavity for Optimum Operation with Type 446B or Type 2C40 R-F Oscillator Tube.

(*1*) These tubes vary considerably in their electrical characteristics, and it may be necessary to adjust the grid cylinder sleeve assembly and the plunger for optimum operation with a replacement tube. The normal length (47) of the grid cylinder sleeve assembly (fig. 20) is 1½ inches. The length is the distance between the open end of the assembly and the rolled bead which fits directly on the grid ring of the 2C40 tube.

(*2*) The fingers of the outer cylinder must firmly contact the main grid cylinder, and the fingers of the main cylinder must make good contact with the grid ring of the tube.

(*3*) To check for frequency coverage and for optimum oscillating conditions, proceed as follows. (It is assumed that the tube is in the cavity, the grid cylinder sleeve assembly is adjusted to its normal length, the grid leak is in position, and that the lead from the grid leak is contacting the grid cylinder sleeve assembly.)

(*a*) Connect the signal generator to the power source and turn the POWER switch to ON, and the R.F. OSC. switch off.

(*b*) Wait several minutes until the instrument has warmed.

(*c*) Set the INT TRIG/CALIB/EXT TRIG selector switch to CALIB.

(*d*) Balance the monitoring meter reading to zero by adjusting the METER ZERO SET control (fig. 5).

(*e*) Throw the R.F. OSC. switch to the ON position.

(*f*) Rotate the R.F. OSC. OUTPUT potentiometer until the monitoring meter reads approximately 160.

(*g*) Turn the R.F. TUNING dial to read 45.

(*h*) Rotate the plunger adjusting sleeve (37) backward or forward until the monitoring meter reading is a maximum.

(*i*) Measure the frequency, or the wavelength, of the oscillator with the tuning dial set at 45 (subpar. b below). If the frequency, or the wavelength, is within the limits of the following table, proceed directly to step (m) below.

(*j*) If the frequency is greater than the values specified in table VI, lengthen the grid cylinder sleeve assembly by about 1/32 inch.

TABLE VI

CAVITY ADJUSTMENT DATA FOR OPTIMUM OPERATION OF SIGNAL GENERATOR TS-155B/UP

	Normal limits with tuning dial reading of 45
Frequency in megacycles	2,795 to 2,810
Wavelength in centimeters	10.69 to 10.74
Length of grid cylinder (par. 45a(1))	1½" ± 3/16"

(*k*) If the frequency is lower, shorten the assembly by about $\frac{1}{32}$ inch.

NOTE: To adjust the grid cylinder sleeve assembly, review the pertinent portions of the instructions for replacing a type 446B tube, paragraph 44a.

(*l*) If, after changing the length of the grid cylinder sleeve assembly within the limits given in table VI, the frequency of the oscillator is not within 7 mc of the indicated range but is very close to it, the frequency may be brought within the limits by a very slight adjustment of the plunger. It must be noted that only a slight adjustment of the plunger is tolerable; otherwise the power output of the cavity may be impaired. The frequency at the 0 and 100 settings of the R.F. TUNING dial should be checked to determine that the entire band from 2,700 to 2,900 mc is covered.

(*m*) Turn the tuning dial slowly from 5 to 95 while watching the monitoring meter. With the R.F. OSC. OUTPUT control on full, the tube should oscillate and give at least a full-scale monitoring meter reading over this range.

b. Frequency Adjustment with Wavemeter Test Set TS-117/GP.

(*1*) Two methods of checking the frequency of the cavity oscillator are shown in figure 36. The method shown in figure 36-A uses a wavemeter containing a crystal. In the method shown in figure 36-B, the crystal contained in Crystal Adapter UG-119/UP is used, and the wavemeter need not be equipped with a crystal. With either of these arrangements, the cavity frequency is adjusted as previously described until the desired frequency range is obtained and the monitoring meter can be made to read at least full-scale at all frequencies in the range. For detailed operation of the wavemeter, refer to TM 11-2538, Wavemeter Test Set TS-117/GP.

(*2*) It may be necessary to produce continuous oscillation for accurate adjustment with Wavemeter Test Set TS-117/GP. Continuous oscillation of the r-f oscillator may be obtained by grounding the cathode of the oscillator tube (left-hand choke terminal as viewed from the rear of cavity) and by inserting a 10,000-ohm resistor in series with the plate of the oscillator tube (at brush near front of cavity).

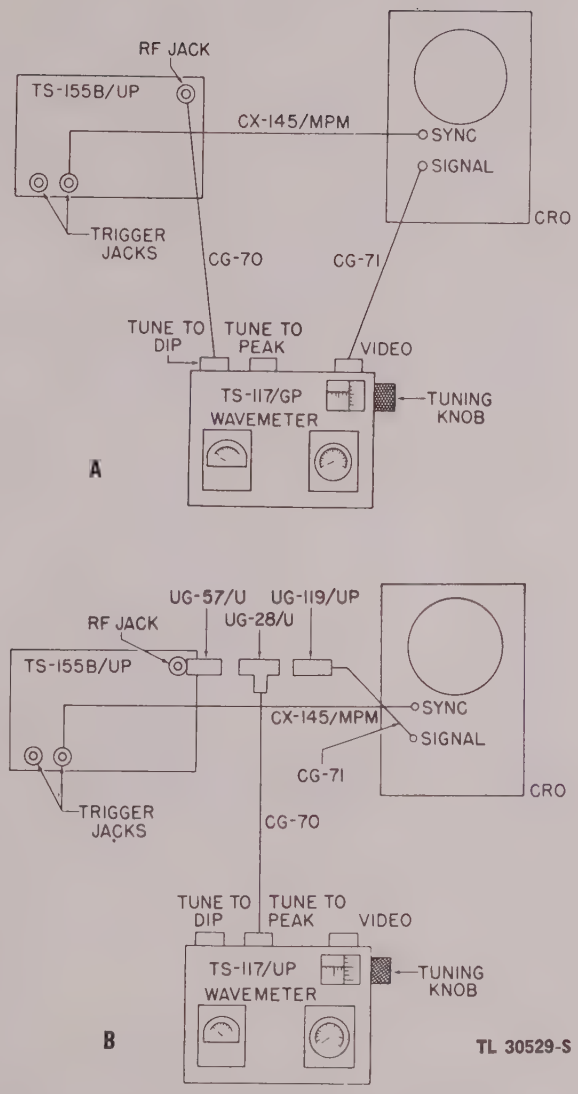


Figure 36. Calibration of Signal Generator TS-155B/UP with Wavemeter Test Set TS-117/GP.

c. Frequency Measurement with Other Test Equipment.

(*1*) If Test Set TS-3/AP (wave and power meter) is used, connect the FREQ. METER cord to the CRYS. IN receptacle of the wave and power meter. Connect the r-f cord to the FREQ. IN receptacle.

(*2*) If Echo Box TS-270/UP or any of its equivalents is used, connect the cord into the input loop receptacle. Refer to figure 36-B. No other connections are necessary.

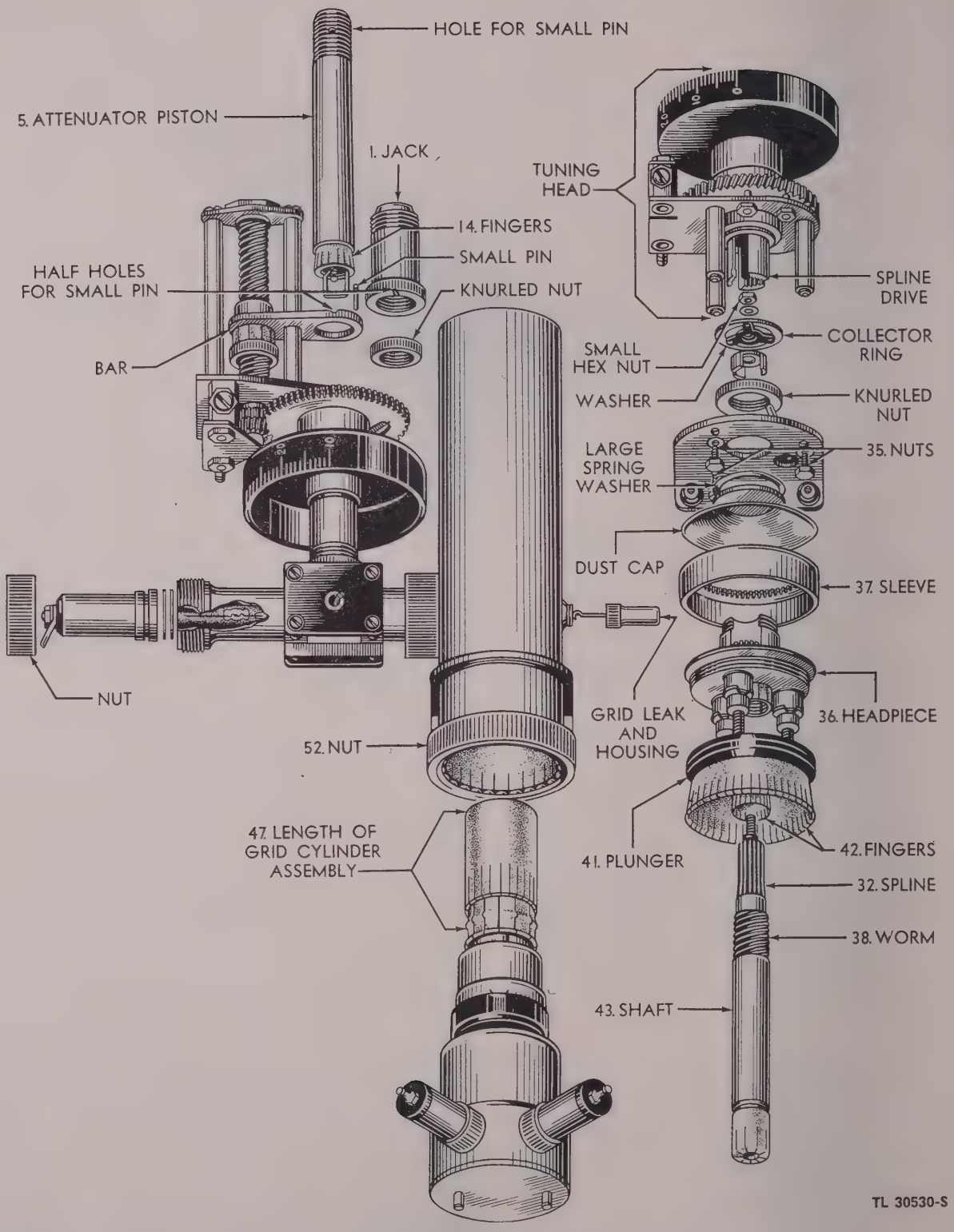


Figure 37. Cavity for Signal Generator TS-155B/UP, disassembly.

46. DISASSEMBLY OF CAVITY (figs. 19 and 20).

a. The cavity should ordinarily not be disassembled except for replacement of the r-f oscillator tube (50) or the thermistors (21, 22, 23). Instructions for these replacement procedures are contained in paragraphs 44a and 44b. By looking into the cavity when the tailpiece (53) is removed, it is possible to observe the condition of the plate cap fingers (45), of the cathode ring of fingers (49), and of that portion of the plate tuning shaft on which the inner ring of fingers of the plunger slide. These contact surfaces may be cleaned, and if the fingers are sprung minor adjustments are possible without disassembly of the cavity.

CAUTION: If the tailpiece (53) is to be removed and replaced, the grid leak housing (48) must first be unthreaded and removed; otherwise, the grid leak sleeve assembly will be damaged.

b. If the cavity proves defective, it should preferably be returned to the factory. However, emergency conditions may necessitate repairs at a repair base, and the following instructions are therefore supplied.

(*1*) Read the description of the cavity mechanism and associated parts in paragraphs 32 and 33. Refer to the cutaway view of the cavity in figure 20 and to the disassembly, figure 37.

(*2*) Access to the bottom of the tube socket and to the filament cathode chokes is gained by unthreading the end plate. Two projection studs are provided on this end plate to assist in removing and replacing it.

(*3*) For further disassembly it is necessary to remove the entire cavity from the front panel. First unsolder or disconnect all cavity leads.

(*a*) Disconnect the flexible cable plug from the attenuator jack (1).

(*b*) Unsolder and remove all thermistor terminal connections.

(*c*) Unsolder or remove the plus and minus B terminal connections at the brush.

(*d*) Unsolder or remove the cathode and filament connections.

(*e*) Remove cavity assembly from front panel by first removing the tuning and attenuator control knobs and then the three securing screws. These screws are identified in figure 5 as numbers 8, 9, and 10.

(*4*) To remove the plunger (41) and plate tuning shaft assembly (43) as a unit, proceed as follows:

(*a*) Adjust the tuning control until the plate tuning shaft is fully out of the cavity.

(*b*) Remove the three hex head screws (35) and washers (use small wrench and tweezers).

(*c*) Pull the tuning dial drive directly off. The spline drive will slide off the spline.

(*d*) Remove the small hex nut and small spring washer that holds the collector ring (33) and remove the collector ring and the three-prong safety stop piece.

(*e*) Remove the knurled nut (34) which secures the bracket. Use pliers guarded with a small piece of cloth.

(*f*) Remove the two screws that hold the bracket to the mounting plate. Remove the bracket.

(*g*) Remove the dust cap and large spring washer.

(*h*) Remove the sleeve (37).

(*i*) Unscrew the headpiece (36). A pair of combination pliers, in conjunction with a piece of cloth to avoid scoring, may be used to grip the projecting portion of this piece.

(*j*) Pull out assembly. Examine and clean.

(*5*) To reassemble the plunger and plate tuning shaft assembly, proceed as follows:

(*a*) Replace the assembly, taking care to avoid damaging the outer ring of fingers (42), and thread on the headpiece. Tighten it.

(*b*) Replace the sleeve (37).

NOTE: To restore the calibration of this sleeve, turn the sleeve fully counterclockwise until the plunger is fully forward in the cavity; then lift the sleeve until it disengages the gear which it operates and rotate the free sleeve until the zero calibration mark lines up with the arrow on the cavity body. Then drop the sleeve in place, meshing it with the gear.

(*c*) Replace the dust cover, the large spring washer, the bracket, and then the knurled nut (34).

(*d*) Replace the two screws in the bottom of the bracket.

(*e*) Replace the three-prong safety stop, then the collector ring (33) with its bakelite face towards

the cavity, then the small spring washer and small hex nut. Finger-tighten this nut.

(*f*) Rotate the plate tuning shaft fully clockwise.

(*g*) Before assembly rotate the tuning dial drive fully clockwise and then mount it, taking care that the tuning control shaft is in the correct position for panel mounting. In this operation it may be necessary to loosen the small hex nut that holds the collector ring and safety stop and to rotate these parts slightly to allow the three sections of the spline drive to pass through the openings in the collector ring and to fit over the spline. A slight pressure is required to force the spline drive over the spline.

(*h*) Tighten the small hex nut that secures the collector ring to the shaft, using a socket wrench through the hollow shaft of the tuning dial.

(*i*) Replace the three hex head screws and small spring washers (35) and tighten them.

(*6*) To remove the attenuator piston (5), proceed as follows:

(*a*) Loosen by several turns the knurled nut which in conjunction with the jack (1) clamps the piston to the bar (3), and slide the piston slightly out of the attenuator tube (13). This exposes a small pin which locates the piston accurately with respect to the bar.

(*b*) Remove this pin; use pliers or tweezers.

(*c*) Remove the jack (1).

(*d*) Compress the piston into the tube far enough to remove the knurled nut, and then remove the piston through the hole in the bar. The piston contact fingers (14) may then be examined and cleaned.

(*7*) To reassemble the piston, proceed as follows:

(*a*) Insert the piston through the hole in the bar and into the attenuator tube, taking care to avoid damaging the contact fingers.

(*b*) Replace the knurled nut.

(*c*) Pull the piston out until the hole for the small pin is visible.

(*d*) Thread the jack on until the half hole in its face lines up with the pin hole in the piston.

(*e*) Insert the pin.

(*f*) Compress the piston in the attenuator tube and rotate until the pin fits into the half hole in the face of the bar.

(*g*) Tighten the knurled nut.

c. If these steps are taken carefully and if the adjusting nut (4) has not been disturbed, the attenuator calibration will not be destroyed.

47. UNSATISFACTORY EQUIPMENT REPORT.

a. When trouble in equipment used by Army Ground Forces or Army Service Forces occurs more often than repair personnel feel is normal, War Department Unsatisfactory Equipment Report, W.D., A.G.O. Form No. 468 should be filled out and forwarded through channels to the Office of the Chief Signal Officer, Washington 25, D. C.

b. When trouble in equipment used by Army Air Forces occurs more often than repair personnel feel is normal, Army Air Forces Form No. 54 should be filled out and forwarded through channels.

c. If either form is not available, prepare the data according to the sample form reproduced in figure 38.

WAR DEPARTMENT

UNSATISFACTORY EQUIPMENT REPORT

FOR	TECHNICAL SERVICE: SIGNAL CORPS MATÉRIEL		DATE: 15 AUG 1945
FROM	ORGANIZATION: 885 SIGNAL REPAIR COMPANY		STATION: APO 888 NEW YORK
TO	NEXT SUPERIOR HEADQUARTERS: SIGNAL OFFICER	STATION: ARMY	TECHNICAL SERVICE:

COMPLETE MAJOR ITEM

NOMENCLATURE	TYPE	MODEL	
SIG. GEN. TS-155B/UP			
MANUFACTURER: BOONTON RADIO CORP.	U. S. A. REG. No.: 896-MPD-45	SERIAL No.:	DATE RECEIVED: 30 MAY 1945

EQUIPMENT WITH WHICH USED (*if applicable*):

DEFECTIVE COMPONENT—DESCRIPTION AND CAUSE OF TROUBLE

PART No.	TYPE	MANUFACTURER	DATE INSTALLED
R89 5Z243	POTENTIOMETER	ROYCE RESISTORS	16 JUN 1945

DESCRIPTION OF FAILURE AND PROBABLE CAUSE (*If additional space is required, use back of form*)

POTENTIOMETER BURNED OUT - TOO LOW WATTAGE RATING

DATE OF INITIAL TROUBLE	TOTAL TIME INSTALLED			TOTAL PERIOD OF OPERATION BEFORE FAILURE					
	YEARS	MONTHS	DAYS	YEARS	MONTHS	DAYS	HOURS	MILES	ROUNDS
2 JUL 1945	0	0	17				5.5		

BRIEF DESCRIPTION OF UNUSUAL SERVICE CONDITIONS AND ANY REMEDIAL ACTION TAKEN

OPERATING IN REGION OF HIGH HUMIDITY

TRAINING OR SKILL OF USING PERSONNEL			RECOMMENDATIONS (*If additional space is required, use back of form*)
POOR	FAIR	GOOD	
		X	REPLACE POTENTIOMETER (R89) WITH ONE HAVING A HIGHER POWER RATING

ORIGINATING OFFICER

TYPED NAME, GRADE, AND ORGANIZATION	SIGNATURE
HAROLD T. MASON, CAPT., SIG. C. 885 SIGNAL REPAIR COMPANY	Harold T. Mason

FIRST ENDORSEMENT

TO CHIEF	TECHNICAL SERVICE	OFFICE	
NAME, GRADE, AND STATION		STATION	DATE

Instructions

1. It is imperative that the chief of technical service concerned be advised at the earliest practical moment of any constructional, design, or operational defect in matériel. This form is designed to facilitate such reports and to provide a uniform method of submitting the required data.
2. This form will be used for reporting manufacturing, design, or operational defects in materiel, petroleum fuels, lubricants, and preserving materials with a view to improving and correcting such defects, and for use in recommending modifications of materiel.
3. This form will not be used for reporting failures, isolated material defects or malfunctions of matériel resulting from fair-wear-and-tear or accidental damage nor for the replacement, repair or the issue of parts and equipment. It does not replace currently authorized operational or performance records.
4. Reports of malfunctions and accidents involving ammunition will continue to be submitted as directed in the manner described in AR 750-10 (change No. 3).
5. It will not be practicable or desirable in all cases to fill all blank spaces of the report. However, the report should be as complete as possible in order to expedite necessary corrective action. Additional pertinent information not provided for in the blank spaces should be submitted as inclosures to the form. Photographs, sketches, or other illustrative material are highly desirable.
6. When cases arise where it is necessary to communicate with a chief of service in order to assure safety to personnel, more expeditious means of communication are authorized. This form should be used to confirm reports made by more expeditious means.
7. This form will be made out in triplicate by using or service organization. Two copies will be forwarded direct to the technical service; one copy will be forwarded through command channels.
8. Necessity for using this form will be determined by the using or service troops.

W. D., A. G. O. Form No. 468
30 August 1944

This form supersedes W. D., A. G. O. Form No. 468, 1 December 1943, which may be used until existing stocks are exhausted.

U. S. GOVERNMENT PRINTING OFFICE 16—41546-1

TL 41743

Figure 38. Sample Unsatisfactory Equipment Report.

48. MAINTENANCE PARTS FOR SIGNAL GENERATOR TS-155B/UP

The following information was compiled on 26 March 1945. The appropriate sections of the ASF Signal Supply Catalog for Signal Generator TS-155B UP are:

Organizational Spare Parts

SIG 7—TS-155B/UP (when published)

Higher Echelon Spare Parts

SIG 8—TS-155B UP when published)

For the index of available catalog sections, see the latest section of ASF Signal Supply Catalog SIG 2.

Ref symbol	*Signal Corps stock No.*	*Name of part and description*
C-1	3DA100-497	CAPACITOR, fixed: paper: 3-sect 100,000-100,000-100,000 mmf ±10%; 600 vdcw; 1¾" lg x 1¾" wd x 5/16" thk; Aerovox type 618 NCB; AWS CP69B5EF104KK; Boonraco part #83057.
C-2 C-10	3K3510312	CAPACITOR, fixed: mica; 10,000 mmf ±5%; 300 vdcw; 53/64" lg x 53/64" wd x 11/32" thk; JAN type CM35A103J; 2 #18 AWG leads 1⅛" lg; Boonraco part #82316.
C-3	3DA250-247	CAPACITOR, fixed: paper; 3-sect 0.25-0.25-0.25 mf ±10% ea sect; 600 vdcw; 3½" h x 1¾" wd x 5/16" thk; Aerovox type 618 MCB; metal case; hermetically sealed; mineral oil; 3 solder lug term spaced ½" c to c on bottom; two 0.144" diam mtg holes spaced 2⅛" c to c at bottom.
C-4 C-5 C-6	3DB4-172	CAPACITOR, fixed: paper: 4 mf +20% −10%; 600 vdcw; 5¼" h; oil-filled; oil-impregnated; aluminum case; Aerovox type 610; CP41B1DF405MK; Boonraco part #83059.
C-7		Part of C-1.
C-8 C-9 C-18	3K2010111	CAPACITOR, fixed: mica; 100 mmf ±10%; 500 vdcw; CM20A101K; Boonraco part #82125; Noma type #1416.
C-11 C-12	3K2047111	CAPACITOR, fixed: mica; 470 mmf ±10%; 500 vdcw; JAN type CM20A471K; Boonraco part #82229.
C-13 C-15	3K3015211	CAPACITOR, fixed: mica; 1,500 mmf ±10%; 500 vdcw; JAN type CN30A152K; Boonraco part #82313.
C-14	3K2015111	CAPACITOR, fixed: mica; 150 mmf ±10%; 500 vdcw; JAN type CM20A151K; Boonraco part #82202.
C-16	3K2091012	CAPACITOR, fixed: mica: 91 mmf ±5%; 500 vdcw; JAN type CM20A910J; Boonraco part #82130.
C-17	3K2024112	CAPACITOR, fixed: mica; 240 mmf ±5%; 500 vdcw; JAN type CM20A241J; Boonraco part #82228.
C-19		Part of C-3.
C-20		Part of C-1.
C-21		Part of C-3.
C-22	3DB2.630-4	CAPACITOR, fixed: paper; oil-filled; oil-impregnated; 2 mf ±10%; 600 vdcw; steel case, 2" lg x 2" wd x 1 5/16" thk; Aerovox type 630E; Boonraco part #83056.
C-23	3K3568211	CAPACITOR, fixed: mica; 6,800 mmf ±10%; 500 vdcw; JAN type CM35A682K; Boonraco part #82415.

48. MAINTENANCE PARTS FOR SIGNAL GENERATOR TS-155B/UP (contd).

Ref symbol	*Signal Corps stock No.*	*Name of part and description*
C-24	3K3010211	CAPACITOR, fixed: mica; 1,000 mmf ±10%; 500 vdcw; JAN type CM30A102K; Boonraco part #82311.
C-25 C-26	3DA500-361	CAPACITOR, fixed: paper; 0.5 mf ±10%; 600 vdcw; AWS CP50B1DF504KK; Aerovox type 630M; Boonraco part #83058; metal can; oil-impregnated.
E-2	2Z9436-15	BOARD, terminal "A": 36 silver-pl solder term; for mtg 16 resistors, 5 capacitors; XXX phenolic 7⅛" lg x 1¾" wd x ⅛" thk; Boonraco part #15043.
E-3	2Z9436-14	BOARD, terminal "B": 36 silver-pl solder term; for mtg 9 resistors, 8 capacitors; XXX phenolic 7⅛" lg x 1¾" wd x ⅛" thk; Boonraco part #15044.
E-4	2Z9436-16	BOARD, terminal "C": 36 silver-pl solder term; for mtg 11 resistors, 4 capacitors, 2 chokes; XXX phenolic 7⅛" lg x 1¾" wd x ⅛" thk; Boonraco part #15045.
E-5	2Z9402.291	BOARD, terminal "D": 2 fuse clips; Littelfuse type 1216; for mtg 2 capacitors, 1 fuse; XXX phenolic 3⅝" lg x 2⅝" wd x ⅛" thk; Boonraco part #15046.
E-6	2Z9402.290	BOARD, terminal "E": 2 fuse clips; Littelfuse 5048G; for mtg 1 resistor; XXX phenolic 3⅛" lg x ⅞" wd x ⅛" thk; Boonraco part #15047.
E-7 E-8 E-9 E-10 E-11 E-12	2Z5822-8	KNOB, octagonal: black bakelite; for ¼" diam shaft; 2 #8-32 Allenhead setscrews 90° apart; white vinylite pointer ⅞" lg measured from center; 1⅛" diam; Kurz-Kasch #S-308-64 (brass insert); Boonraco part #87002.
E-13	2Z5821-4	KNOB, round: black bakelite; hole for ¼" shaft; 1 #6-32 Allenhead setscrew ⅝" diam x ⅜" thk; Davies #1450; Boonraco part #87063.
E-14 E-15	2Z5850-71	KNOB, round: black bakelite; hole for 3/16" shaft; 2 #6-32 Allenhead setscrews 1 1/16" diam x 11/16" thk; ARC #11715.
E-16	3F3988-67	ANTENNA, assembly: AN Antenna AT-67/AP; Boonraco part #15052.
E-17	2Z308-131	ADAPTER, connector: SigC Adapter UG-131/U; Boonraco part #15053.
E-18	2Z308-119	ADAPTER, crystal: SigC Crystal Adapter UG-119/UP; Boonraco part #15053.
E-19	2J1N21B	CRYSTAL, 1N21B: Boonraco part #15054.
E-20	2Z7390-28	ADAPTER, tee: Sig C Radio-Frequency Adapter UG-28/U; Boonraco part #15055.
E-21	2Z7390-57	ADAPTER, type "N" connector: Sig C Radio-Frequency Adapter UG-57/U; Boonraco part #15056.
F-1	3Z1927	FUSE, glass: 2 amp, 250v; 1¼" x ¼" diam; Buss 3AG2; Boonraco part #93251.
F-2	3Z2572-2	FUSE, glass: ½ amp, 250v, 1¼" x ¼" diam; Littelfuse #1261; Boonraco part #93661.
H-1	2Z2636-28	CLAMP, tube: type #302 stainless steel; 1 5/32" diam x ¾" h; Birtcher #926A (1 mtg bracket; equipped w/holding spurs) for VR105 and VR150; Boonraco part #93620.
H-2	2Z5042-4	CLAMP, tube: type #302 stainless steel; 1¼" diam x ¾" h; Birtcher #926B (1 mtg bracket; equipped w/holding spurs) for 5Y3GT; Boonraco part #93621.

48. MAINTENANCE PARTS FOR SIGNAL GENERATOR TS-155B/UP (contd).

Ref symbol	*Signal Corps stock No.*	*Name of part and description*
H-3	3F4325-155/3	SCREW, thumb: captive; cylindrical head; 7/16″ diam, 13/32″ thk; steel nickel-plated; #8-32 thd; 5/32″ lg x 29/32″ over-all lg; H&R; S.S. (coarse straight knurl unthd portion 0.098″ diam); Boonraco part #15036.
I-1	2Z5952	LAMP, incandescent: 6v, 0.15 amp; miniature bayonet base; single cont; Sylvania S-47; Boonraco part #01027.
J-1 J-2	2Z8799-239	CONNECTOR, female contact: UHF coax; straight, 1 1/16″ lg x 5/8″ diam; Ucinite, Sig C Socket SO-239 (mica-filled bakelite insulation; 24 thd per inch; lg of thd 3/8″; 4 mtg holes in metal plate 1″ sq; Boonraco part #89001.
J-3	2Z7390-16	CONNECTOR, female contact: polystyrene insulation; straight type "N"; coax 1 25/32″ lg x 5/8″ diam on end; Cundy-Bettoney; AN Radio-Frequency Jack UG-16/U; (24 thd per inch; 13/32″ diam small end; 4 mtg holes in metal plate 1″ sq); Boonraco part #94057.
L-1	3C323-6X	COIL, radio, AF: filter choke; single winding 10 hy, 125 ma 250 ohm; 3-1/4" h x 20-15/16" lg x 2-9/16" wd; Freed Trans Part # 12657; inclosed metal case form mtg studs #10-32 x 9/16" lg; 2 solder lug term; Boonraco part #85427.
L-2	3C323-157A	COIL, radio, RF: choke; integral type; unshielded; 100μh ±10%; 5 ma; d-c resistance approx 2.7 ohms; approx 5/8″ lg x 3/8″ d; mtg 2 axial wire leads 1 1/2″ lg; Essex Electronics A362; Boonraco part #85426.
L-3	3C323-157B	COIL, radio, RF: choke; integral type; unshielded; 10 μh ±10%; 5 ma; d-c resistance approx 0.9 ohms; 5/8″ lg x 3/8″ diam; mtg 2 axial wire leads 1 1/2″ lg; Essex Electronic A361; Boonraco part #85425.
M-1	3F872-18	METER, microammeter: 0-200 μa; 68 ohms; round, bakelite flush mtg case; 2.695″ diam flange x 2.21″ diam body x 1.125″ d; Marion Elec Co; 3 mtg holes 1/8″ diam on flange spaced 120° apart on circle of 1.22″ rad; 2 stud term #10-32 x 3/4″ lg, 1″ c/c; Boonraco part #92021.
R-1	3RC30BF332K	RESISTOR, fixed: composition; 3,300 ohms ±10%; 1w; JAN RC30BF332K; Boonraco part #80259.
R-2 R-16	3RC20BF103K	RESISTOR, fixed: composition; 10,000 ohms ±10%; 1/2w; AWS RC20BF103K; Boonraco part #80361.
R-3	3RC20BF153K	RESISTOR, fixed: composition; 15,000 ohms ±10%; 1/2w; AWS RC20BF153K; Boonraco part #80336.
R-4	3RC20BF623J	RESISTOR, fixed: composition; 62,000 ohms ±5%; 1/2w; AWS RC20BF623J; Boonraco part #80551.
R-5	2Z7272-208	RESISTOR, variable: carbon; 500,000 ohms; 2w, 3 term; body 1 1/16″ diam x 9/16″ d; AB #JB5041; (B taper counterclockwise logarithmic; inclosed body; bushing 3/8″ d x 32 thd per inch x 3/8″ lg; shaft 1/4″ diam extends 1/2″ from bushing); Boonraco part #81605.
R-6	3RC20BF512J	RESISTOR, fixed: composition; 5,100 ohms ±5%; 1/2w; AWS RC20BF512J; Boonraco part #80362.
R-7 R-21	3RC20BF102K	RESISTOR, fixed: composition; 1,000 ohms ±10%; 1/2w; AWS RC20BF102K; AB; Boonraco part #80148.
R-8	3RC20BF104K	RESISTOR, fixed: composition; 100,000 ohms ±10%; 1/2w; AWS RC20BF104K; Boonraco part #80517.

48. MAINTENANCE PARTS FOR SIGNAL GENERATOR TS-155B/UP (contd).

Ref symbol	*Signal Corps stock No.*	*Name of part and description*
R-9 R-14	3RC20BF475K	RESISTOR, fixed: composition; 4.7 meg ±10%; ½w; AWS RC20BF475K; Boonraco part #80641.
R-10	2ZK7279-32	RESISTOR, variable: WW; 200 ohms; 4w; 3 term; body 1¾″ diam x 13/16″ d; Wirt type A (linear taper inclosed body; bushing ⅜″ diam 32 thd x ½″ lg; shaft end is slotted for screwdriver locking device); Boonraco part #81111; JAN RA30A1RA201AK.
R-11	3RC20BF105K	RESISTOR, fixed: composition; 1 meg ±10%; ½w; AWS RC20BF105K; Boonraco part #80621.
R-12 R-45	3Z6400-102	RESISTOR: WW; 4,000 ohms ±5%; 10w; 1⅞″ lg x ½″ diam; Sprague type 10KT; ceramic insulation; ⅝″ solder lug each end; Boonraco part #80258.
R-13	3Z6300-179	RESISTOR: WW; 3,000 ohms ±5%; 10w; 1⅞″ lg x ½″ diam; Sprague type 10KT; ceramic insulation; ⅝″ solder lug each end; Boonraco part #80257.
R-15	3RC20BF473K	RESISTOR, fixed: composition; 47,000 ohms ±10%; ½w; AWS RC20BF473K; Boonraco part #80460.
R-17	3RC20BF332K	RESISTOR, fixed: composition; 3,300 ohms ±10%; ½w; AWS RC20BF332K; Boonraco part #80253.
R-18	3RC20BF333K	RESISTOR, fixed: composition; 33,000 ohms ±10%; ½w; AWS RC20BF333K; Boonraco part #80461.
R-19	3RC30BF223K	RESISTOR, fixed: composition; 22,000 ohms ±10%; 1w; AWS RC30BF223K; Boonraco part #80404.
R-20	2Z7274-53	RESISTOR, variable: carbon; 1 meg; 2w; 3 term; body 1 1/16″ diam x 9/16″ d; AB (linear taper; inclosed body; bushing ⅜″ diam x 32 thd per inch x ⅜″ lg; shaft ¼″ diam extends ½″ from bushing); Boonraco part #81603.
R-22	2Z7271-102	RESISTOR, variable: carbon; 100,000 ohms; 2w; 3 term; body 1 1/16″ diam x 9/16″ d; AB (linear taper; inclosed body; bushing ⅜″ diam x 32 thd per inch x ⅜″ lg; shaft ¼″ diam extends ½″ from bushing); Boonraco part #81504.
R-23	3RC20BF821J	RESISTOR, fixed: composition; 820 ohms ±5%; ½w; AWS RC20BF821J; Boonraco part #80171.
R-24	3Z6615-144	RESISTOR: WW; 15,000 ohms ±5%; 5w; 1 3/16″ lg x ½″ diam; Sprague type 5KT; ceramic insulation; ⅝″ solder lug ea end; Boonraco part #80368.
R-25	2Z7296-2A	RESISTOR, variable: WW; 50,000 ohms; 4w; Boonraco part no. 81404
R-26	3Z6620-158	RESISTOR: WW; 20,000 ohms ±5%; 5w; 1 3/16″ lg x ½″ diam; Sprague type 5KT; ceramic insulation; ⅝″ solder lug ea end; Boonraco part #80369.
R-27	3RC20BF335K	RESISTOR, fixed: composition; 3.3 meg ±10%; ½w; AWS RC20BF335K; Boonraco part #80644.
R-28	3RC20BF105K	RESISTOR, fixed: composition; 1 meg ±10%; ½w; AWS RC20BF105K; Boonraco part #80621.
R-29	2Z7270.119	RESISTOR, variable: carbon; 50,000 ohms; 2w; 3 term; body 1 1/16″ diam x 9/16″ d; AB (linear taper inclosed body; bushing ⅜″ diam x 32 thd per inch x ⅜″ lg; shaft ¼″ diam extends ½″ from bushing); Boonraco part #81406.

48. MAINTENANCE PARTS FOR SIGNAL GENERATOR TS-155B/UP (contd).

Ref symbol	*Signal Corps stock No.*	*Name of part and description*
R-30	3RC20BF272K	RESISTOR, fixed: composition; 2,700 ohms ±10%; ½w; AWS RC20BF272K; Boonraco part #80225.
R-31	2Z7272-11	RESISTOR, variable: carbon; 500,000 ohms; 2w, 3 term; body 1 1/16" diam x 5/16" d; AB #JU5041; inclosed body; bushing 3/8" d x 32 thd per inch x 3/8" lg; shaft ¼" diam extends ½" from bushing; Boonraco part #81451.
R-32	3RC20BF475K	RESISTOR, fixed: composition; 4.7 meg. ± 10%; 1/2w; JAN RC20BF475K; Boonraco part #80641.
R-33	3Z6610-253	RESISTOR, fixed: WW; 10,000 ohms ±10%; 10w; 1 7/8" lg x 7/16" diam; Sprague type 10KT; vitreous insulated; 2 solder lug term; Boonraco part #80371.
R-34	3RC30BF182K	RESISTOR, fixed: composition; 1,800 ohms ±10%; 1w; AWS RC30BF182K; Boonraco part #80254.
R-35	3RC20BF125K	RESISTOR, fixed: composition; 1.2 meg ±10%; ½w; AWS RC20BF125K; Boonraco part #80646.
R-36	3RC20BF222K	RESISTOR, fixed: composition; 2.2 K ±10%; ½w; AWS RC20BF222K; Boonraco part #80256.
R-37	3RC20BF331K	RESISTOR, fixed: composition; 330 ohms ±10%; ½w; AWS RC20BF331K; Boonraco part #80172.
R-38	3RC20BF390J	RESISTOR, fixed: composition; 39 ohms ±5%; AWS RC20BF390J; Boonraco part #80031.
R-39	3RC20BF101K	RESISTOR, fixed: composition; 100 ohms ±10%; ½w; AWS RC20BF101K; Boonraco part #80062.
R-40	3RC30BF334K	RESISTOR, fixed: composition; 330,000 ohms ±10%; 1w; AWS RC30BF334K; Boonraco part #80647.
R-41	3RC20BF272K	RESISTOR, fixed: composition; 2700 ohms ± 10%; 1/2w; JAN RC20BF272K; Boonraco part #80255
R-42	3RC20BF223K	RESISTOR, fixed: composition; 22,000 ohms ±10%; ½w; AWS RC20BF223K; Boonraco part #80402.
R-43	3RW29104	RESISTOR, fixed: WW; 6,300 ohms ±5%; 20w; Sprague type 20F; AWS #RW15F632; Boonraco part #80363.
R-44	3Z7335-5	RESISTOR, variable: WW; 3,500 ohms; 4w; 3 term; body 1¾" diam x 13/16" d; Wirt type A (linear taper inclosed body; bushing 3/8" diam 32 thd, ½" lg; shaft extends ⅛" from end of bushing ¼" diam; shaft end slotted for screwdriver; locking device); Boonraco part #81206.
R-46	3Z7250-27	RESISTOR, variable: WW; 500 ohms; 3w; 3 terms; body 0.98" lg x 1.78" diam w/shaft ¼" diam x 7/8" lg from mtg surface; Boonraco part #81110; linear; inclosed body; 3/8"-32 NEF2 x 0.375" lg bushing.
R-47	3RC20BF390J	RESISTOR, fixed: composition; 39 ohms ±5%; ½w; AWS RC20BF390J; Boonraco part #80031.
R-48	3RC20BF360J	RESISTOR, fixed: composition; 36 ohms ±5%; ½w; AWS RC20BF360J; Boonraco part #80029.
R-49	3Z6926-11	RESISTOR, thermal: disk thermistor; approx 765 ohms at 75°F ±5%; mtg rectangular metal plate 1¼" lg x 7/8" wd; over-all height 5/16"; WECo D-168391; mtg holes 1" apart horizontally; wire lead 4" lg; Boonraco part #02072.

48. MAINTENANCE PARTS FOR SIGNAL GENERATOR TS-155B/UP (contd).

Ref symbol	*Signal Corps stock No.*	*Name of part and description*
R-50	3RC20BF471J	RESISTOR, fixed: composition; 470 ohms ±5%; ½w; AWS RC20BF471J; Boonraco part #80170.
R-51 R-52 R-53 R-56	3RC20BF241J	RESISTOR, fixed: composition; 240 ohms ±5%; ½w; AWS RC20BF241J; Boonraco part #80174.
R-54	3RC20BF200J	RESISTOR, fixed: composition; 20 ohms ±5%; ½w; AWS RC20BF200J; Boonraco part #80097.
R-55	3Z6926-12	RESISTOR, thermal: disk thermistor; approx 803 ohms at 75°F ±5%; over-all height 5/16"; mtg rectangular metal plate 1¼" lg x ⅞" wd; WECo #D168392; 4 mtg holes 1" apart horizontally, ⅝" apart vertic); flexible wire leads 4" lg; Boonraco part #02073.
R-57	3Z6926-12.4	RESISTOR, thermal: bead thermistor glass envelope; 33-47 ohms w/25 ma; 13/32" lg x ⅛" diam; WECo #D163903 (glass insulation; axial wire leads 1¾" lg); Boonraco part #02074.
S-1	3Z9863-22K	SWITCH, toggle: DPST; black bakelite; 1 9/32" lg x 23/32" wd x 23/32" h; AWS ST22K (250v, 3 amp; bushing 15/32" x ½" diam); 4 solder lug term; Boonraco part #88042.
S-2A B-C-D E-F	3Z9825-62.235	SWITCH, rotary: 3 position; 6 sect; ceramic body; 2" diam x 2 5/8" lg; Oak #28647 (shaft ¼" diam x 7/16" lg; bushing ⅜" diam x ⅜" lg; solder lug term); Boonraco part #88038.
S-3	3Z9863-26N	SWITCH, toggle: DPDT; black bakelite; 1 9/32" lg x 23/32" wd x 23/32" h; (250v; 3 amp; bushing ½" lg); 6 solder lug term; AH&H; AWS ST26N; Boonraco part #88040.
S-4	3Z9858-23	SWITCH, toggle: SPST; black bakelite; 1 9/32" lg x 23/32" wd 23/32" h; (250v, 3 amp; bushing ½" lg x ¼" diam); 2 solder lug term; AH&H; AWS ST16A; Boonraco part #88018.
T-1	2Z9619-143	TRANSFORMER, power: plate and fil; fully inclosed steel case; 4½" lg x 2¾" wd x 4¾" h; Freed #12490 (pri 115v; 50 to 800 cycles; secd 350-O-350 h voltage at 125 ma DC, 6.3v at 4.5 amp fil; 5.0v at 3.0 amp; rectifier; 4 mtg studs #10-32 x 5/16; 9 insulated term on bottom); Boonraco part #85056.
T-2	2Z9638-45	TRANSFORMER: (blocking oscillator) 50-2,500 cyc; painted steel case 2½" h x 1¾" lg x1½" wd; Freed #14292; 6 lug term on bottom; 4 mtg inserts #6-32 x 5/16"; ⅞" x 1 11/32" mtg centers, 3 windings; Boonraco part #85057.
V-1A 1B V-2A 2B V-3A 3B V-4A 4B	2J6SN7GT	TUBE, electron: JAN 6SN7.
V-5	2J6AG7	TUBE, electron: JAN 6AG7.
V-6	2J2C40	TUBE, electron: JAN 2C40.
V-7	2J5Y3GT	TUBE, electron: JAN 5Y3GT.
V-8	2JOD3/VR150	TUBE, regulator: JAN VR150-30.
R-58	3RC20BF562K	RESISTOR, fixed; composition; 5600 ohms ±10%; 1/2w; JAN RC20BF562K; Boonraco part #80376.

48. MAINTENANCE PARTS FOR SIGNAL GENERATOR TS-155B/UP (contd).

Ref symbol	*Signal Corps stock No.*	*Name of part and description*
V-9	2JOC3VR105	TUBE, regulator: JAN VR105-30.
W-1	3E7279	CABLE, assembly: r-f coax; AN Radio-Frequency Cable RG-38/U; flexible characteristic impedance 51 ohms; 8¾" lg between plugs; AN Radio-Frequency Jack UG-16/U on one end; AN Radio-Frequency Plug UG-15/U on one end; Boonraco part #15907.
W-2	3E6000-145	CABLE, assembly: AN Cord CX-145/MPM; Boonraco part #15007.
W-3	1F430-70	CABLE, assembly: AN Cord CG-70/MPM; Boonraco part #15906.
W-4	1F430-71	CABLE, assembly: AN Cord CG-71/MPM; Boonraco part #15908.
*1	3F47800-3	CAVITY, assembly: oscillator tunable band; ARC #E311; Boonraco part #15007.

* Maintenance item not referenced on drawing.

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